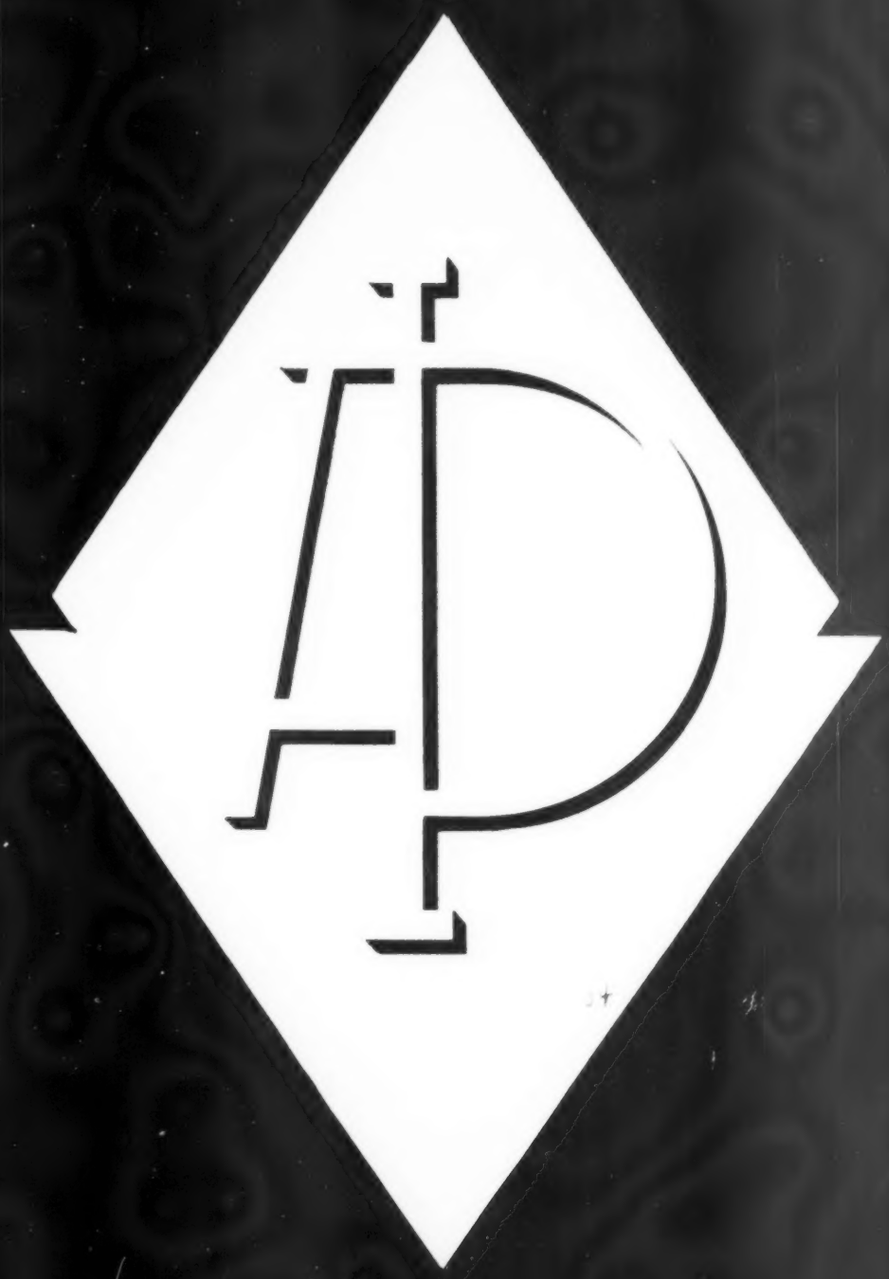
WORLD PETROLEUM

NOVEMBER, 1945



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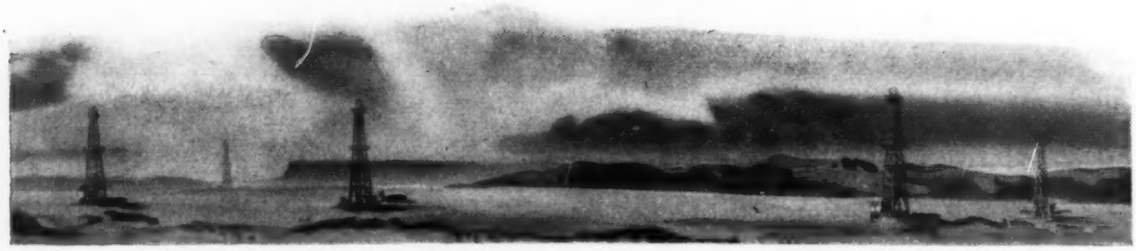


EDITORIAL

A QUARTER-CENTURY OF NATIONAL SERVICE

THE American Petroleum Institute came into legal existence in March 1919. Its first quarter century, therefore, was completed in 1944 but at that time its members were too busily engaged in supplying products indispensable to success in the fight for freedom to take note of the event. It is perhaps fortunate that the observance of this silver anniversary had to be deferred. Now, with the war triumphantly ended, it can be combined with a Victory Jubilee to mark the outcome in which oil has been a decisive factor.

Born of the united effort through which the oil industry contributed so mightily to Allied success in World War I, the Institute was established in the spirit of national service which has been its guiding principle ever since. It is noteworthy that the outstanding purposes announced in its original by-laws were "to afford a means of cooperation with the government in all matters of national concern", and "to promote the study of the arts and sciences connected with the petroleum industry". Its founders were content to leave to other organizations matters of trade policy, price questions and problems of local or sectional concern. They sought to establish a body that would promote the efficiency of the industry, increase its ability to serve the public and give strength to the nation whenever such support was needed. How steadily and how effectively these aims have been kept in view is attested by the inspiring progress of the oil industry during the past two and a half decades culminating in the proud record written in the titanic struggle just ended.

To the petroleum industry and to its individual members perhaps the greatest contribution of the Institute has been in providing a forum for discussion, a clearing house for ideas and a cooperative agency for the encouragement of technical progress. Through the studies conducted by its hundreds of committees and the papers presented at its national and divisional meetings it has collected and disseminated information that added vastly to the useful knowledge not only of its own members but of all those engaged in the industry's operations. Its discussions have stimulated initiative and have led to the development of numberless improvements in practices and appliances.

Moreover the Institute itself has been responsible for many activities of sorts that can best be conducted by collective rather than by individual effort. One of its early undertakings and one that has been maintained through the years has been to bring about the adoption of uniform standards of equipment. This has saved the industry millions of dollars annually. It has led to the acceptance of API specifications as standard throughout the world.

Safety measures advocated by the Institute have been the means of saving thousands of lives and preventing property losses too great to be computed. The death rate from accidents among oil workers which once was abnormally high has been reduced well below the average for all forms of industry. The Institute's activities have included studies of fundamental problems that have had an important bearing on the applied research conducted by private companies and organizations. These are but a few of the many activities of the Institute but they serve as an indication of its constructive influence in keeping the industry's steps constantly in the paths of progress.

Through the habit of working together for the technical advancement of their industry under the leadership of the Institute the oil men of America, during the two decades following its organization, laid the groundwork for fulfilling the second declared purpose of their association. The emphasis upon research to develop better processes and products, the practice of making new ideas and improved methods available for general adoption and the pressure for finding new and broader uses for their products resulted in a rapid advancement during this period such as was hardly equalled by any other industry. It put the oil fraternity in a position of instant readiness to "cooperate with the government in matters of national concern" when the need for such cooperation became of immediate and vital importance to the nation's safety.

It was no accident that the oil industry was prepared to meet the test of war when the critical hour arrived. Years of study and experimentation had entered into the perfection of the processes which made possible the production on a vast scale of the specialized products which fueled the mightiest combination of air, sea and ground power ever marshalled for combat.

Cooperation for technical progress during the years of peace readied the industry to close ranks, to share patented processes on which millions had been spent and to pool its full resources at the call of the government. The story of the oil industry's part in World War II has been written in deeds of imperishable valor and in victories around the world that will be remembered as long as freedom remains. Its achievements were not the work of any one group for practically every member of the industry had some part in making them realities. But it cannot be gainsaid that the effectiveness of the oil industry's efforts was heightened by the spirit of service inculcated by the Institute throughout its career, the spirit which remains its guide for the future.

AMERICAN PETROLEUM INSTITUTE ROUNDS OUT QUARTER-CENTURY OF OIL INDUSTRY LEADERSHIP

THE letters API have long stood for progress in the oil industry. There is dramatic propriety in the fact that the organization of which these letters are the symbol, which was so greatly instrumental in preparing the industry for its vital role in World War II, should have been nurtured by World War I. The steady but unspectacular advance in processes and products that marked the progress of the oil industry in the quarter century between these two events found full expression in the overwhelming aggregation of power that brought victory to the United Nations.

When that earlier conflict engulfed Europe and reached across the Atlantic to embroil the United States there was no national association representative of the petroleum industry as a whole. Yet it was realized that oil was of primary importance to the military operations of the Allies and that America was the only source from which it could be obtained in sufficient quantity. Coordination of the country's productive power, refining capacity and transportation facilities was needed to meet the situation. It called for a pooling of resources in an industry in which unremitting competition had been the keynote of activity.

Under these conditions the War Industries Board asked A. C. Bedford of the Standard Oil Company of New Jersey to organize the National Petroleum War Service Committee. He called in leading oil company executives and the committee was organized with Mr. Bedford as chairman and James A. Moffett of the Standard Oil Company of New Jersey as secretary. Other members of the original group were George W. Davison, president of Gulf Oil Corporation; E. C. Lufkin, president of The Texas Company; H. F. Sinclair, president of Sinclair Oil and Refining Company; J. W. Van Dyke, president of the Atlantic Refining Company; E. L. Doheny, president of California Petroleum Company, and John H. Markham, oil producer of Tulsa, Okla. As time went on others were added. By the close of the war, in 1918, the membership had risen to thirty-five of whom twenty-three represented independent producers and regional associations and twelve were identified with so-called major companies.

The story of the highly effective work performed by this committee has been told before*.

William R. Boyd, Jr., Ninth President

Though there were dark days when the mounting toll of tankers taken by enemy submarines threatened to bring Allied naval operations to a halt and when the conservation of domestic supplies led to the adoption of gasolineless Sundays the committee always found ways of getting oil to the places where it was needed, and on time. Through a combined effort maintained and managed by the industry itself every military demand was met and the result was summed up in the oft-quoted phrase, "The Allies floated to victory on a sea of oil".

Through their experience in working together to meet wartime requirements members of the committee were impressed with the advantages of an association that could deal with many problems of the oil industry without interfering

*See World Petroleum, Nov. 1940. "Petroleum Industry's Wartime Service" by James A. Moffett.

National Petroleum War Service Committee, Forerunner of the American Petroleum Institute, Meeting in 1918. Left to right, Seated: A. C. Bedford, E. C. Lufkin, Judge Carey, Mark Requa, J. W. Van Dyke, George W. Davison, Edward Prize, Thomas O'Donnell, Ivy Lee, Samuel Messer, H. L. Doherty, Commodore O'Donnell E. W. Clark, R. D. Benson (Right Foreground), A. G. Maguire, W. P. Cowan, H. M. Blackmer, H. E. Felton and J. S. Cosden. Standing Left to Right: W. C. Teagle, James O'Neill, H. F. Sinclair, John Markham, George Crawford, J. Howard Pew, (Unidentified), J. A. Moffett, Joseph Guffey, (Unidentified), (Unidentified), W. S. Farish, (Unidentified), (Unidentified), R. L. Welch and A. P. Coombe.

in any way with the competitive activities of its members. At the post-war convention of the United States Chamber of Commerce held in Atlantic City in December, 1918, a group session of oil men adopted a resolution calling upon the National Petroleum War Service Committee to formulate a plan for a permanent and comprehensive national organization of the oil industry.

As an outgrowth of this action, backed by the general feeling that there was a useful field of activity for such an association, the American Petroleum Institute was organized and incorporated March 20, 1919 in the District of Columbia. It is significant that the name "Institute" was adopted. It signalized the purpose of the founders to bring the study of technical problems and efficient operating methods within the purview of the new organization instead of having its attention confined within the limits of the ordinary commercial trade association. Significant, too, were the declared objectives of the Institute as stated in its by-laws:

(a) To afford a means of cooperation with the government in all matters of national concern,

(b) To foster foreign and domestic trade in American petroleum products,

(c) To promote the mutual improvement of its members and the study of the arts and sciences connected with the petroleum industry.

Throughout the quarter century of its existence these aims have been kept steadily in view and the Institute has not deviated from them although the scope of its operations has been vastly extended.

Thomas A. O'Donnell, one of the most popular and best known men in the industry, who had served as director of production on the staff of Mark L. Requa when Mr. Requa was head of the petroleum division of the Fuel Administration, was selected as the first president of the Institute. Robert L. Welch, who had been the active manager of the Western Petroleum Refiners' Association and in that capacity had been closely associated with the operations of the war service committee, was drafted as general secretary and counsel.

It was largely due to the efforts of these two men that the American Petroleum Institute became established from the beginning as a truly national and representative organization. They traveled about the country visiting local oil men, answering their questions, overcoming objections and impressing upon them the advantages to the oil industry and to its members of a strong and enterprising organization to represent it. They literally sold the Institute to the industry to such good effect that at the end of its first year it had a membership of 1349. That enrollment has since increased to more than 4200.

Mr. O'Donnell remained at the head of the Institute for five years, until 1924. Under his direction it gained a firm foothold and the main lines of the activities it was to follow were put into operation. Following his retirement from the executive position he continued as a director and maintained his interest in the Institute's work up to the time of his death only a few months ago. Bob Welch, who was the wheel horse of the organization in its early days, was an able lieutenant of President O'Donnell and is generally credited with having done more than any other one man in organizing the several divisions of the Institute and putting them into

Thomas A. O'Donnell, First President, 1919-1924

efficient operation. He retained his post up to the time of his death, in January, 1929.

One of the early additions to the Institute's small staff was a young Texan named Bill Boyd who joined the organization on November 5, 1920, with not well defined duties but who was soon made Welch's right-hand man with the title of assistant general secretary and counsel. The team of Welch and Boyd worked together so harmoniously and effectively that upon the passing of the former, Boyd was agreed upon as his successor with the title of executive secretary. Today, as president of the Institute, his period of service covers exactly twenty-five years and the November meeting will mark his silver jubilee as well as that of the organization. Unlike most of the members of the Institute staff Boyd had no previous connection with any oil company and no special knowledge of the industry. But he has had occasion to learn a lot about it since.

Following Tom O'Donnell a procession of distinguished members of the industry have occupied the Institute's presidential chair. The second incumbent, in 1925, was J. Edgar Pew who at 75 is still one of the most energetic members of the oil fraternity and serves in the important post of chairman of the Institute's committee on reserves. Third in line was W. S. Farish, later to become the head of Standard Oil Company (New Jersey) and to die in harness during the war just ended.

Following him for the two years 1927-28 was E. W. Clark, president of Union Oil Company of California. The fifth president was E. B. Reeser, president of Barnsdall Oil Company, who served three terms from 1929 to 1931. Up to the end of Mr. Reeser's incumbency the office of president had been a purely honorary and financially barren position. With the growth of the Institute's activities and the increasing demands upon the time and attention of its executive head it was felt that it should be a salaried position enabling the president to devote his full energies to the work. This has been the rule since that time.

First to serve under the revised arrangement and sixth to hold the office was Judge Amos L. Beaty in 1932. He was followed by Judge Charles B. Ames who resigned in May 1933 to become chairman of The Texas Company. His successor was Axtell J. Byles who previously had been chairman of Tide Water Associated Oil Company. He served continuously from 1933 to the time of his death in 1941 and was the first president to die in office.

When it became necessary to select a ninth president to fill the vacancy caused by the death of Mr. Byles, the industry faced a period of uncertainty clouded by the many problems raised by the war then under way in Europe and by the imminent prospect that the United States would shortly be drawn into the conflict. In this emergency the directors turned to W. R. Boyd, Jr., the lad from Texas who for twenty years had been familiarizing himself with every phase of the industry's operations and who had been the acting president during the final months of Mr. Byles' illness. Bill Boyd thereupon became the first president of the Institute to rise from the ranks of the organization; the first who had no past affiliation with any oil company. The wisdom of the choice has been amply verified by the brilliant record of the industry under his leadership both as head of the Institute and chairman of the Petroleum Industry War Council during the trying years since 1941.

J. Edgar Pew, Second President, 1925

W. S. Farish, Third President, 1926

The governing body of the Institute is its board of directors. At the time of its formation the board consisted of forty members and included most of the men who had served on the Petroleum War Service Committee from which the Institute sprang. With the passage of years the size of the board has been gradually increased to include a balanced representation of all branches of the industry and it now numbers 110. Directors are elected for two year terms so that half the membership is renewed each year. A body of this size possesses the advantage of including representatives of every phase of the industry and every part of the country but it is rather unwieldy to supervise the detailed operations of the organization. That function rests with an executive committee of 25 members elected by the board.

Management of the Institute's affairs is in the hands of the president, three vice presidents, one each for production, refining, and marketing, a secretary, treasurer and assistant treasurer.

These officers are elected annually by the board of directors. Office headquarters are located in New York but the Division of Production operates from Dallas, Texas, because of its geographical position near the center of the greatest producing section of the country. A branch office is maintained in Washington and a statistical office in Los Angeles, California.

E. W. Clark, Fourth President, 1927-1928

In addition to its three main divisions the Institute maintains five departments each operating under a director who is a member of the organization's staff. These are the Department of Accident Prevention, the Department of Engineering, the Department of Statistics, the Department of Information, and the American Petroleum Industries Committee. Each of these titles is self-explanatory except that of the American Petroleum Industries Committee which deals particularly with tax matters and state legislation and uses its influence to see that the proceeds from state taxes on gasoline are applied to highway improvement, the purpose for which they were originally imposed.

Much of the work sponsored by the Institute is carried on by its large number of national and regional committees made up of members who are specialists in the various operations of the industry. Some of these are standing committees dealing with operations that are subject to continuous development, such as drilling practices, refinery technology and standardization of equipment. Others are topical committees the members of which devote themselves to the study of special or local problems that arise from time to time. Each of the five regional districts into which the country is divided for the study of technical questions has its own organization and its own group of committees and holds meetings usually twice a year for the presentation and discussion of technical questions. These gatherings with the fall and spring meetings of the Institute as a whole, provide frequent symposiums covering the current progress of the industry in all matters of interest. Some 2,000 practical oil men are enrolled in these various committees, through which the Institute has mobilized practically the entire industry to keep abreast of new ideas and practices and to work for greater efficiency.

Some of the movements fostered by the Institute have been the means of tremendous savings to the oil industry while at the same time greatly simplifying its operations. An outstanding example is the work of the committee on standardization of oil field equipment. Prior to the organization of the Institute there was no uniformity in the dimensions of drill pipe, casing and other field equipment and operators could never be certain in ordering parts that they would fit those they already had in use. Through the work of the special committee set up under the Division of Production uniform standards were worked out for pipe threads, joints, pipe and other equipment and these standards have been adopted all over the world so that API specifications are used throughout the industry in ordering parts with full assurance of their interchangeability. Without such uniformity of standards it would be impossible to conduct oil industry operations on their present worldwide scale and the drilling of a single well would be much more expensive and time consuming than it now is.

Akin to the development of standardization of equipment has been the adoption of codes of recommended practice in the measuring, sampling and testing of crude oil and natural gasoline, in the use of tools and other equipment used in drilling and producing wells, in the determination of permeability, in the evaluation of drilling mud weight and in various other operations. Fifteen such codes have been established.

Studies of corrosion likewise have resulted in large financial savings to the industry by determining its causes and the means of its prevention through which the life span of line pipe and other equipment has been greatly lengthened.

In a somewhat different field the Institute has been responsible for the introduction of uniform methods of accounting. Accountancy is the means by which the value of properties is determined and in the oil industry, dealing as it does with assets that are gradually being used up and must continually be replaced, the system adopted for charging depletion, depreciation and the valuation of intangible assets is particularly important. Standardization of methods is of value to the industry in its relations with tax authorities and other government bureaus and affords the investing public the only means of determining the worth of securities offered to it.

From the very beginning the Institute has given special attention to the promotion of safety in the operations of the industry, the prevention of accidents, the elimination of fire hazards and the avoidance of wastes. Departmental activities in relation to safety measures are governed by a central committee which includes the safety engineers and safety supervisors of numerous oil companies. The committee serves as a forum for discussion and a clearing house of ideas. Under its direction the department compiles and issues information on safe operating practices, injuries and fatalities, motor vehicle accidents and other related subjects. Through the efforts of oil company managements and the training of employees the proportion of fatal

C. B. Ames, Seventh President, First Half of 1933

Amos L. Beaty, Sixth President, 1932

E. B. Reeser, Fifth President, 1929-1931

Axtell J. Byles, Eighth President, 1933-1941

First Meeting of P.I.W.C. December 8, 1941

Robert Leslie Welch, Member of the Committee and First General Secretary.

accidents in 1943 was less than half that of 1928. Injuries among oil workers which were 18 percent more frequent in 1927 than the average for all industries were 11.4 percent below that average in 1943.

Like other departments of the Institute the Division of Refining carries on its work through a number of committees and sub-committees. Its technical activities are directed by the central committee on refinery technology through seven topical committees. The Division has cooperated with various technical societies such as the American Society of Mechanical Engineers, the American Society for Testing Materials, the American Standards Association and other engineering bodies in the study of problems in which the oil industry has a collateral interest. One of the first official acts of the Institute's directors was the appointment of a Motor Fuels Committee which led to the formation of the Cooperative Fuel Research Committee in conjunction with representatives of the National Automobile Chamber of Commerce, the Society of Automotive Engineers and the United States Bureau of Standards. The work of the CFR in conducting tests of motor fuels and establishing standards of performance has been of great value both to the automotive and oil industries. A more recent joint enterprise was the establishment in 1942 of the Coordinating Research Council by the Institute and the Society of Automotive Engineers for the study of problems mutual to the automotive, aeronautical and petroleum industries. Most of the Council's attention during the past three years has been directed to the study of problems relating directly to the war.

Supplementing the extensive research activities of individual oil companies the Institute has carried on a research program of its own which has included studies on a wide variety of subjects during the past twenty years. Established in 1926 by grants from John D. Rockefeller and Universal Oil Products Company the program has always been maintained outside the Institute's regular budget. Its cost, now amounting to nearly $200,000 annually, is met by contributions by interested oil companies.

The usual procedure followed in the study of individual problems is to make an appropriation to some university or scientific body which conducts the investigation and makes a report of its findings. At the present time some eight or ten such projects are under way.

One of the earliest activities undertaken by the Institute was the collection and distribution of statistics on oil production and refining operations. The weekly bulletin giving this and other statistical information is a useful index of the state of the industry and is extensively read and quoted. The Department of Information issues press releases and technical reports and publishes the Institute's quarterly magazine and a biennial handbook of statistical information.

A comprehensive description of the Institute's activities would fill a very large volume but the examples given perhaps will convey some impression of the wide range of its operations which touch upon every phase of the industry, keep its members and the public informed, provide a constant stimulus to progress and fulfill the objective set forth in its original charter, "to promote the mutual improvement of its members and the study of the arts and sciences connected with the petroleum industry."

Another purpose set forth in the by-laws of the organization was to cooperate with the government and to supply it with information regarding the operations of the oil industry. It is safe to say, however, that the men who framed this document little realized the dimensions which this task of meeting official demands for information, answering attacks and preparing reports would attain or that during long periods it would occupy practically the full time of the Institute's management. Such, nevertheless, has proved to be the case.

Investigation of the oil industry has grown to be a Congressional habit. Attempts to establish federal control over the industry have been frequent and inquisitions by one government bureau or another have been numerous. The burden of preparing reports, answering charges and presenting the industry's case before committees and commissions is one that has devolved largely upon the management of the Institute.

In the very first year of the Institute's life the Federal Trade Commission undertook an investigation of the oil industry to determine its responsibility for rising prices. Evidence collected by the Institute demonstrated that the increase was due to economic causes and resulted in a favorable report. The Department of Justice

Robert E. Allen, Director, Department of Information.

Lacey Walker, Secretary and Assistant Treasurer.

C. A. Young, Secretary, Division of Production.

followed with an attempted prosecution of oil companies for raising fuel oil prices in the Middle West. Committees of the Institute presented facts which provided an effective rebuttal of the charge.

In 1924 President Coolidge established the Federal Oil Conservation Board to examine the petroleum resources of the country and to propose means by which their waste could be avoided. In behalf of the oil industry the Institute immediately offered its full cooperation with the Board and during the years immediately following numerous committees of the Institute collected statistical information for its use and collaborated in the consideration of problems of conservation and efficient operation. Out of these joint efforts grew the Interstate Oil Compact and other constructive measures including a code of practices for the marketing of petroleum products which received the approval of the Federal Trade Commission and later served as a model for the code adopted by the National Industrial Recovery Administration under the Roosevelt Administration. One of the by-products of cooperation between the industry and the Federal Conservation Board was the preparation of an exhaustive report entitled "American Petroleum—Supply and Demand" which was published in book form.

In 1934, following the federal government's essay in the management of business, including oil, Congress decided upon another extended investigation of petroleum. This was conducted by the celebrated Cole Committee which accumulated one of the most elaborate records ever compiled for any industry, the testimony and statements of witnesses filling nearly 3000 printed pages. Again the Institute, in cooperation with other oil industry organizations, marshalled an imposing array of facts and figures for the use of the Congressmen and arranged for the appearance of prominent oil men at the committee hearings. The net result of the Cole committee's studies extending over half a dozen years was the decision that national legislation for regulation of the oil industry was not necessary.

Another elaborate study of the American industrial system was undertaken by federal authority in 1939 through the Temporary National Economic Committee. Once more the oil industry was put under the microscope but on this occasion the industry was permitted to tell its own story through a program sponsored by the Institute and the collected testimony on petroleum filled seven volumes of over 3,000 pages in the TNEC record.

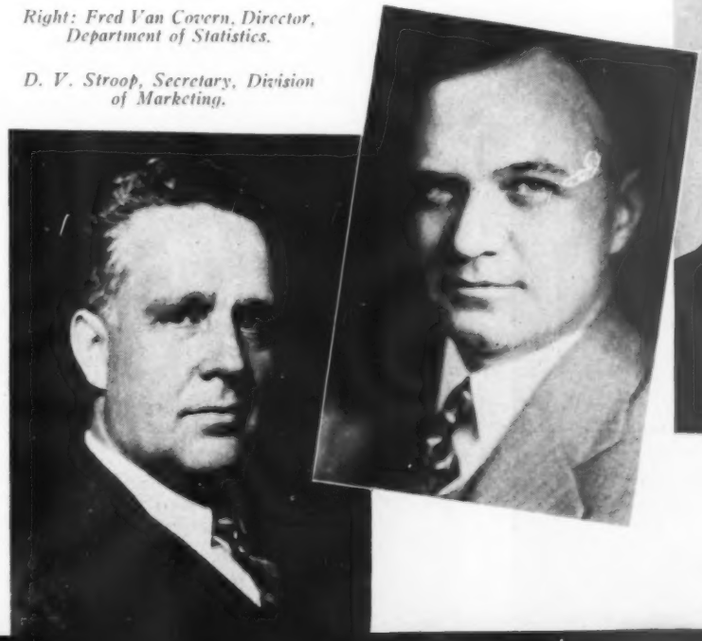
With the gathering of war clouds over Europe and as the United States was drawn closer and closer to the conflict, a new chapter, the most critical in its history, began to be written by the American oil industry. During 1940 and 1941 its members were active in preparations for fulfilling their share in the national defense as proposed by the military and civil authorities of the government. When the blow was struck on December 7, 1941 that made the United States an active combatant in the world struggle the full energies of the industry were mobilized for war. The governmental machinery for aiding the transformation of the oil business from a peacetime pursuit followed by thousands of actively competing units into a single solid front devoted to the one purpose of winning the war had been set up in the Office of Petroleum Administration. On the day following Pearl Harbor the Petroleum Administrator met with representative oil men from all parts of the country in Washington and organized the Petroleum Industry War Council to act as his advisory board and to make the ability and experience of men from every branch of the oil trade available for the tremendous task of oiling a world wide war—a war that could not have been fought or won without oil.

For the exceedingly difficult post of executive head of the Council, the unanimously approved selection was William R. Boyd, Jr., the young man from Texas whose career had been linked with that of the American Petroleum Institute from the beginning, who for more than score of years had been in training, all unconsciously of course, for the special service to his country that now devolved upon him. The story of the Petroleum Industry War Council does not belong here but in effect it includes the story of the American Petroleum Institute for the past four years. Many of the Institute staff and practically all its numerous committees were occupied with work relating to the conduct of the war. Institute activities as such were reduced to a minimum. Due to war's exactions the Institute even had to postpone the meeting scheduled for 1944 which was to mark the twenty-fifth anniversary of its founding. Due to the speed with which the war was brought to a close, however, largely because of the enormous outpouring of petroleum products for military use, it is now possible to celebrate this silver anniversary combined with the industry's well earned Victory Jubilee.

Baird H. Markham, Director, American Petroleum Industries Committee.

Right: Fred Van Covern, Director, Department of Statistics.

D. V. Stroop, Secretary, Division of Marketing.



PETROLEUM INDUSTRY FACES NEW PROBLEMS

By William R. Boyd, Jr.

President, American Petroleum Institute

WE are today faced with the problem of how to conduct our business in a changed — and changing — world. The changes are profound and far-reaching. They embrace every phase of the petroleum industry, every activity in which we presently engage. And, as we look ahead, we see even more profound changes ahead of us.

I view these changes not as a hazard but as a challenge to the skills, the ingenuity and the alert abilities of the oil men of the United States. We have been surviving change since the beginning of this industry and we will continue to progress as long as men of vision are free to change with changing times.

A variety of questions are before us. What fuels, for instance, will tomorrow's airplanes require? Will motor trucks demand diesel fuel or gasoline? What new production techniques are in the making and what should the trend be? In what direction is the world oil situation trading? These questions come readily to mind and there are numerous others of which all of us are aware.

I don't know the answers to these questions and I doubt if any man would attempt to answer them today. I have complete confidence in one thing, however, and that is that together we can answer them. Together, we have answered every question and every problem that has confronted the industry in more than a generation.

Working together, we have advanced petroleum geology from a set of theories to a sound technical science that unlocks the secrets of the earth. We have improved the art of drilling to the end that wells more than three miles deep are no longer a novelty. We have established sound conservation practices so that recovery has jumped from 20-30 per cent of the recoverable oil to 70-80 per cent. We have worked out a safety program second to none. We have brought refining to unimagined heights.

Working together during the war, under the guidance and direction of the Petroleum Administration for War, we provided the lifeblood of the great fighting machine that smashed the Axis powers. In fact, we did more than that. We provided literally hundreds of new and essential products for our fighting men and their weapons.

That working together must not be allowed to lapse. In fact, it must be intensified and strengthened in the days ahead. We must work harder, if possible, to make more and better petroleum products for a world that is badly in need of them.

With these thoughts in mind, I deemed it imperative to call the twenty-fifth annual meeting of the Institute at Chicago November 12-15, in spite of a congested hotel situation. The work of the organization must go forward; the many committees of the Institute must meet and continue the excellent work they have done in the past. The Board of Directors must assemble and consider many pressing questions. Facilities and service will not be up to former standards, but I am sure everyone understands that. Hotels are congested in every large city in the country and in most of the small ones. We cannot wait for that condition to pass to carry forward the business of the organization.

So to those who can attend this annual meeting, I extend a most hearty welcome and the assurance of a program second to none in the history of the Institute. The many committees are doing splendid work in preparing programs of interest and importance not only in their particular sphere, but to the industry as a whole. The general sessions promise to be the best in years, with speakers of national importance on subjects of national and international interest. I am confident that at the end of the meeting, all who attend will agree that the program was well worth whatever minor inconveniences may have been encountered.

We have demonstrated in the past quarter century that our industry can freely exchange useful information for the benefit of all and still remain sharply competitive. That competitive spirit, as a matter of fact, is largely responsible for the great advancement that has been made in the petroleum sciences. Competition spurs men on to new achievements and one man's idea leads to other new ideas in the minds of other men.

Let me emphasize that the Institute is a gathering of men, of individuals, not of companies nor of dollars. Men of many companies, large and small; individual operators and heads of large concerns, always have joined hands in carrying on the work of the organization. Men who have something to contribute to the good of the industry attend these meetings, because they feel they will take home with them something of importance, something they did not know before.

This twenty-fifth annual meeting will be no exception. Because of the impact of the war and the many new developments that occurred during its course, there is more useful information to exchange than ever before. Because no meeting was held in 1944, important work has piled up that must be expedited rapidly.

American industrial "know-how" proved its worth during the war as it never was proved before. It must again prove its worth in these shifting tides of peace. It must seek constantly to provide more products and greater service to the end that the standard of living for every American is raised. It can do that. Given the opportunity it can provide good jobs at good pay for every man willing to work who possesses some worthwhile skill. Technical progress is the answer, as the petroleum industry has so clearly demonstrated. A part of that technical progress has been developed through the work of the Institute of which the annual meetings are an important part.

It is my sincere hope that every oil man in the United States who wants to attend the twenty-fifth annual meeting at Chicago may be able to do so. I hope that some sort of accommodations, however crowded, can be found for all.

To those who are unable to attend I can only say that the petroleum trade press, as well as the Institute, will bring them the entire story of the proceeding as rapidly as it can be transmitted. If you can't be there in person, we hope you will be there in spirit, and we will tell you all about it later.

To all the rest! "See you in Chicago."

Dr. Clark Goodman

C. R. Smith

Lt. Gen. James H. Doolittle

PROGRAM AMERICAN PETROLEUM INSTITUTE

Twenty-fifth Annual Meeting and Victory Jubilee

NOVEMBER 12 to 15, 1945 — STEVENS HOTEL, CHICAGO

Wednesday, November 14, 9:30 AM

DIVISION OF PRODUCTION

Well Spacing and Production Allocation: (South Ball Room)
(Sponsored by the Special Study Committee on Allocation of Production and Well Spacing)
Presiding: Edgar Kraus, The Atlantic Refining Co., and H. H. Kaveler, Phillips Petroleum Co.

Optimum Well Spacing

A Factual Analysis of the Effect of Well Spacing on Oil Recovery.

A Re-examination of Production Data on Mexia-Powell Fault-Line Fields.

9:30 AM — (Grand Ball Room)

DIVISION OF REFINING

Research and Technology:
Presiding: Harry Levin, The Texas Co.

No Peace for Fractionators.
P. J. Harrington, B. L. Bragg III, and C. O. Rhys, Jr., Standard Oil Development Co.

The Story of the Technical Oil Mission.
A. E. Miller, Sinclair Refining Co.

Investigation of European Synthetic-Oil Industry.
W. J. Schroeder, Bureau of Mines, Department of the Interior.

Address:
Colonel Donald L. Putt, Deputy Commanding General, Intelligence (G-2), Air Technical Service Command.

Coordinating Research Council in the Days to Come.
K. G. Mackenzie, The Texas Co.

2:30 PM — (Grand Ball Room)

GENERAL SESSION

Report of Board of Councillors and Election of Directors.

President's Address:
William R. Boyd, Jr., President, American Petroleum Institute; Chairman, Petroleum Industry War Council.

Address:
Ralph K. Davies, Deputy Petroleum Administrator for War.

Address:
C. R. Smith, Chairman of the Board, American Airlines, Inc.

Address:
Dr. Virgil Jordan, President, National Industrial Conference Board.

8:00 PM — (Grand Ball Room)

GENERAL SESSION

Address:
Hon. Harold L. Ickes, Secretary of the Interior; Petroleum Administrator for War.

Address:
Lieutenant-General James H. Doolittle, U. S. Army Air Corp.

Address:
Lieutenant-General Raymond S. McLain, U. S. Army.

Thursday, November 15, 9:30 AM

DIVISION OF PRODUCTION

Technology of Water Injection: (South Ball Room)
(Sponsored by the Topical Committee on Production Technology)
Presiding: J. E. Sherborne, Union Oil Co. of California and Paul D. Torrey.

Thursday, November 15, 9:30 AM

DIVISION OF PRODUCTION

Injection of Water into Underground Reservoirs in Michigan.
W. E. Schoeneck, The Ohio Oil Co.

Technology of Water Injection in the Allegany Field, New York.
George W. Holbrook and Wilbur H. Young, Bradley Producing Corp.

The Behavior of Water-Input Wells.
Parke A. Dickey, Quaker State Oil Corp., and Kurt H. Andresen, South Penn Oil Co.

Report of Division's Nominating Committee.
Carl E. Reistle, Jr., Humble Oil and Refining Co., Houston Texas, Chairman.

Election of Twenty Members of the General Committee of the Division of Production.

9:30 AM — (Grand Ball Room)

DIVISION OF REFINING

Catalytic Cracking:
Presiding: H. W. Field, The Atlantic Refining Co.

Liquid Charge Technique in TCC Cracking.
T. P. Simpson, Socony-Vacuum Oil Co., Inc. and H. G. Shimp, Houdry Process Corp.

Peacetime Fuel Oils from War Equipment.
J. R. Bates, J. B. Hill, and Arthur E. Pew, Jr., Sun Oil Co., Philadelphia, Pa.

High-Capacity Operation of Fluid-Cracking Units.
E. V. Murphree, E. J. Gohr, H. Z. Martin, H. J. Ogorzaly, and C. W. Tyson, Standard Oil Development Co.

Report of Division's Nominating Committee.
T. G. Delbridge, The Atlantic Refining Co., Philadelphia, Pa., Chairman.

Election of Twenty Members of the General Committee of the Division of Refining.

9:30 AM — (North Ball Room)

DIVISION OF MARKETING

Marketing Session:
Presiding: E. V. Weber, Eureka Oil Co.

Gasoline Quality.

Fuel-Oil Availability.

World Supplies of Gasoline, Kerosene, and Burning Oils.

Report of Division's Nominating Committee.
W. C. Burns, Richfield Oil Corp. of New York, New York, N. Y., Chairman.

Election of Twenty Members of the General Committee of the Division of Marketing.

2:30 PM — (Grand Ball Room)

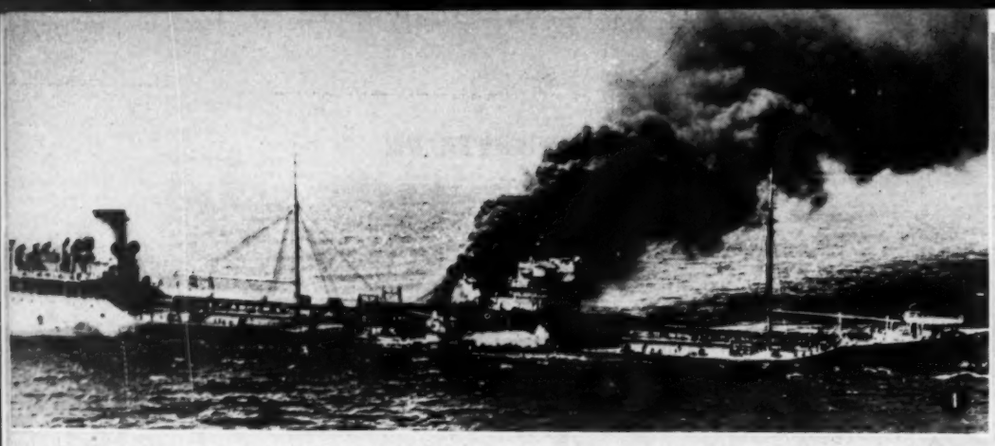
GENERAL SESSION

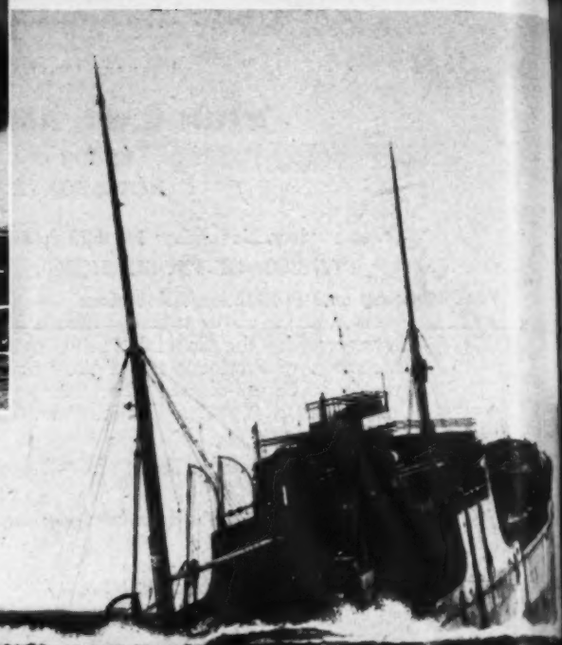
Address:
Vice Admiral Ben Moreell, Chief of the Bureau of Yards and Docks and Office in Charge of Navy Petroleum Plant Office, Washington, D.C. —with Captain B. W. Gillespie, Executive Officer, Navy Petroleum Plant Office, Washington, D.C., and Commander J. G. King, Navy Petroleum Officer, Chicago, Ill.

Petroleum vs Plutonium.
Dr. Clark Goodman, Massachusetts Institute of Technology, Cambridge, Mass.

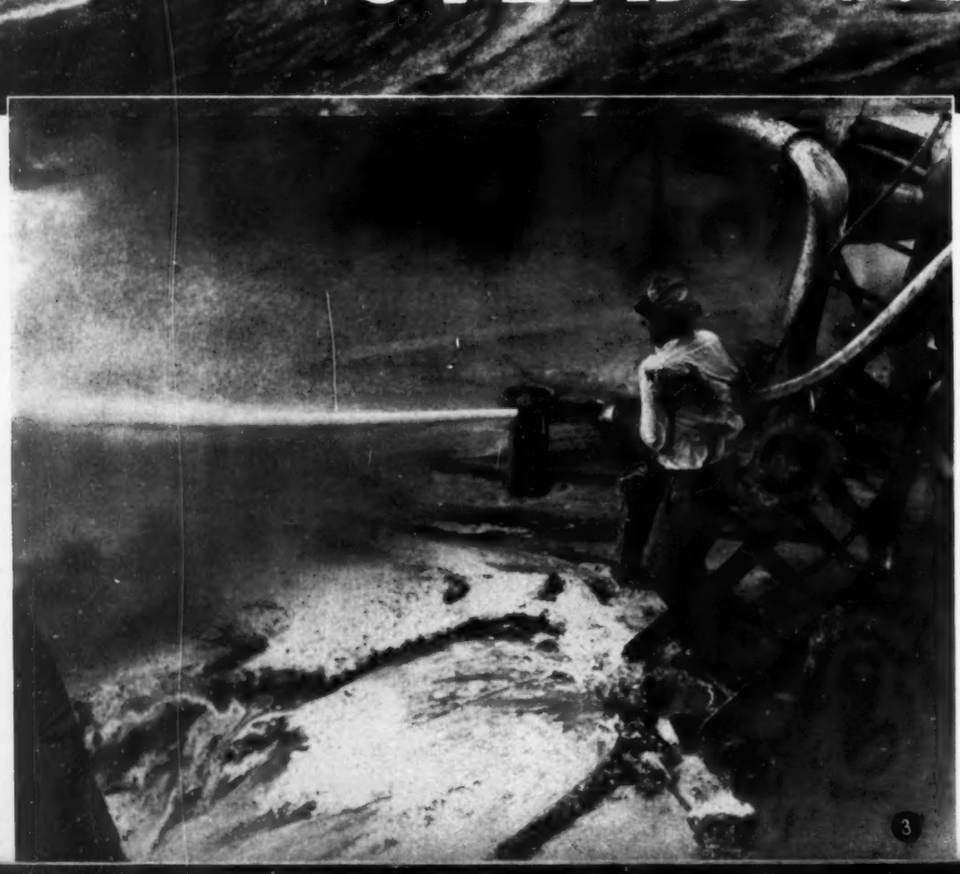
History Looks at Oil.
Dr. Paul H. Giddens, Curator of the Drake Well Memorial Park and Museum, Titusville, Pa.

Address:
Speaker to be announced.





OILING WORLD WAR II



MAY 1941

22nd, President declares unlimited national emergency—28th, President appoints Harold Ickes Petroleum Coordinator for National Defense—Major companies recommend Big and Little Inch Lines.

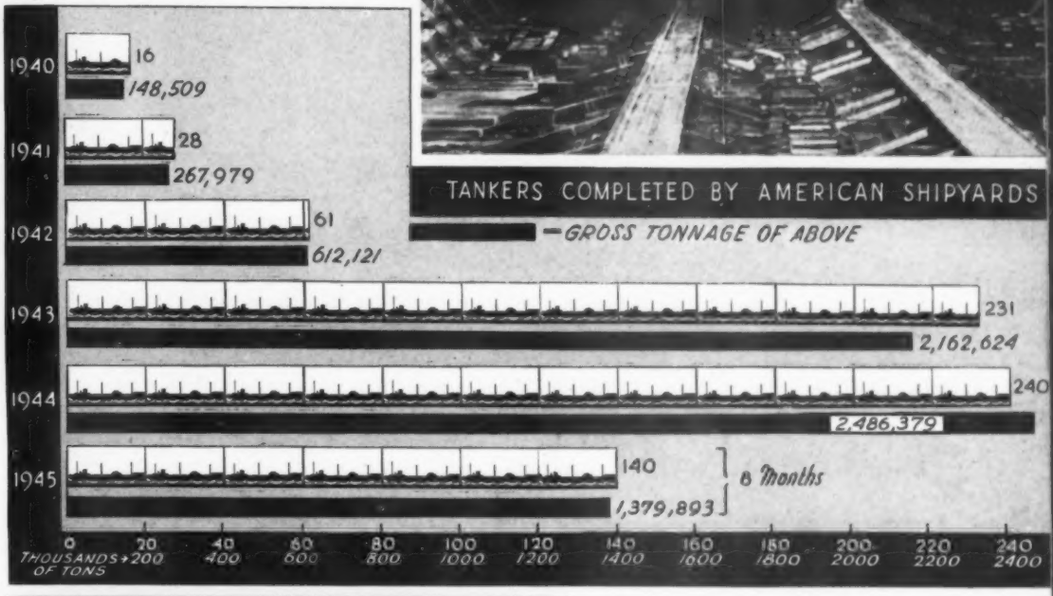
JUNE 1941

Ralph K. Davies appointed Deputy Oil Coordinator—U. S. oil shipments to Japan stopped—Netherlands stops oil, rubber, tin shipments to Japan—Ickes decides to increase aviation gasoline production 25%—Surveys of pipelines to east begun by private companies.

JULY 1941

Rationing talked—Emergency tank car shipments to east begun—Steel refused for pipelines to east—Five district oil coordination offices opened.

1. *Fire Amidships from an Enemy Torpedo*
2. *More Than 100 American Tankers Were Sunk*
3. *Heroic Seamen Stood and Fought*
4. *Many a Damaged Ship Reached Port*
5. *Fueling at Sea Extended Naval Operations*
6. *Shipyards More Than Made Good Losses at Sea*
7. *Convoys Got Through with Fuel and Food*



AUGUST 1941

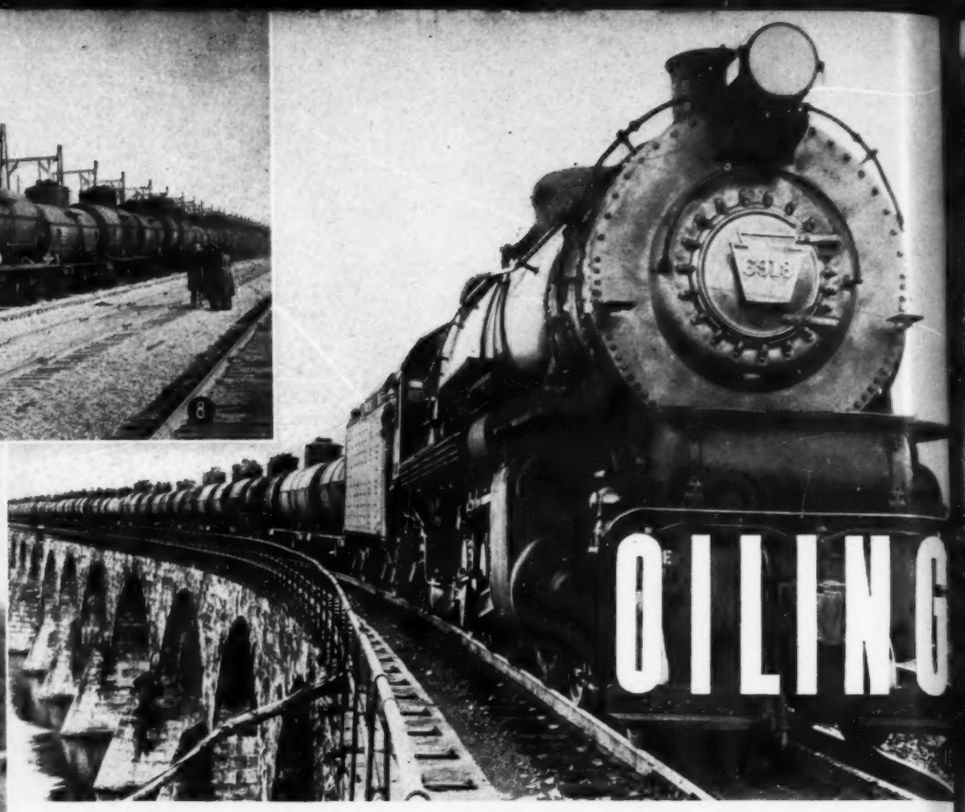
Tankers diverted to Russia—Industry asked to double aviation gasoline production at cost of $10 millions.

SEPTEMBER 1941

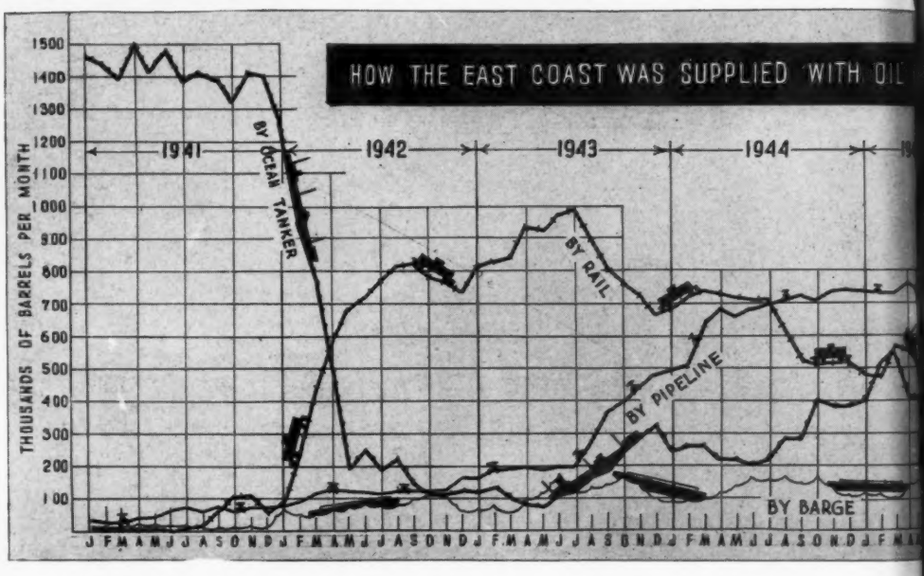
Flow is reversed in eastern pipelines—More tank cars sought as shipments to east coast reach 100,000 barrels per day.

OCTOBER 1941

Aviation gasoline production now 40,000 barrels per day, industry asked to triple this by middle of 1942—Fifty new 100-octane units to cost $150,000,000 planned—Pipeline steel request refused for second time.



OILING W



NOVEMBER 1941

Crude production 4,329,365 barrels per day —30,000 wells asked for 1942—5,846,000 tons of steel allocated to oil industry—Oil prices frozen.

DECEMBER 1941

7th, Pearl Harbor—8th, PIWC organized —TEL under allocation—Axis submarines begin sinking tankers on Atlantic seaboard.

JANUARY 1942

Maximum production of butanes and isopentane requested—Development wells restricted to one well to 40 acres by M-68—Contracts let on 100-octane and toluene plants—Octane number of premium gasoline reduced—U. S. synthetic rubber production only 30,000 tons per year, program begun to produce 400,000 tons per year at plants to cost $400,000,000.

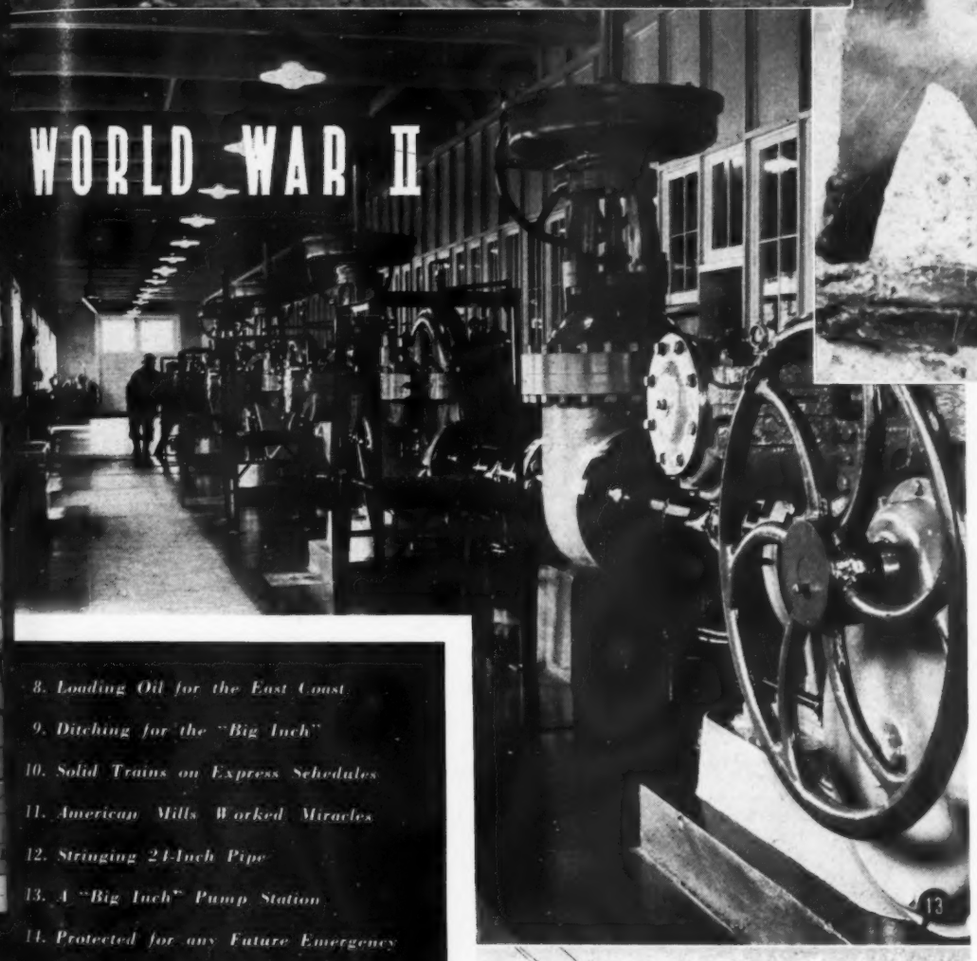
FEBRUARY 1942

Inadequate pipe line capacity causes proration in some fields—Ickes resumes fight for big inch oil line—Tin for oil packages restricted.

MARCH 1942

WPB turns down Big Inch—OPA approves 25¢ advance in Pennsylvania crude and higher east coast prices.

WORLD WAR II



8. Loading Oil for the East Coast

9. Ditching for the "Big Inch"

10. Solid Trains on Express Schedules

11. American Mills Worked Miracles

12. Stringing 24-Inch Pipe

13. A "Big Inch" Pump Station

14. Protected for any Future Emergency

15. In Rain or Snow Welding Went On

APRIL 1942

Study digging up western pipeline relaying to alleviate east coast shortage.

MAY 1942

District 1 gas rationing.

JUNE 1942

WPB approves Big Inch to Norris City, Ill.—Quickie butadiene plan proposed.

JULY 1942

9th, First 24″ pipe produced—18th, First 24″ pipe shipped.

AUGUST 1942

3rd, First 24″ pipe laid—Gasoline tank car shipment within 100 mile radius in twenty mid-western states banned by OPC.

SEPTEMBER 1942

Tank car shipping ban increased to 200 miles.

OCTOBER 1942

Fuel oil rationing begun in 30 east and mid-west states—26th, Decide to extend 24″ to east coast.

NOVEMBER 1942

Extension of Big Inch to east approved—17th, Eastern "A" coupons cut from 4 to 3 gallons.

DECEMBER 1942

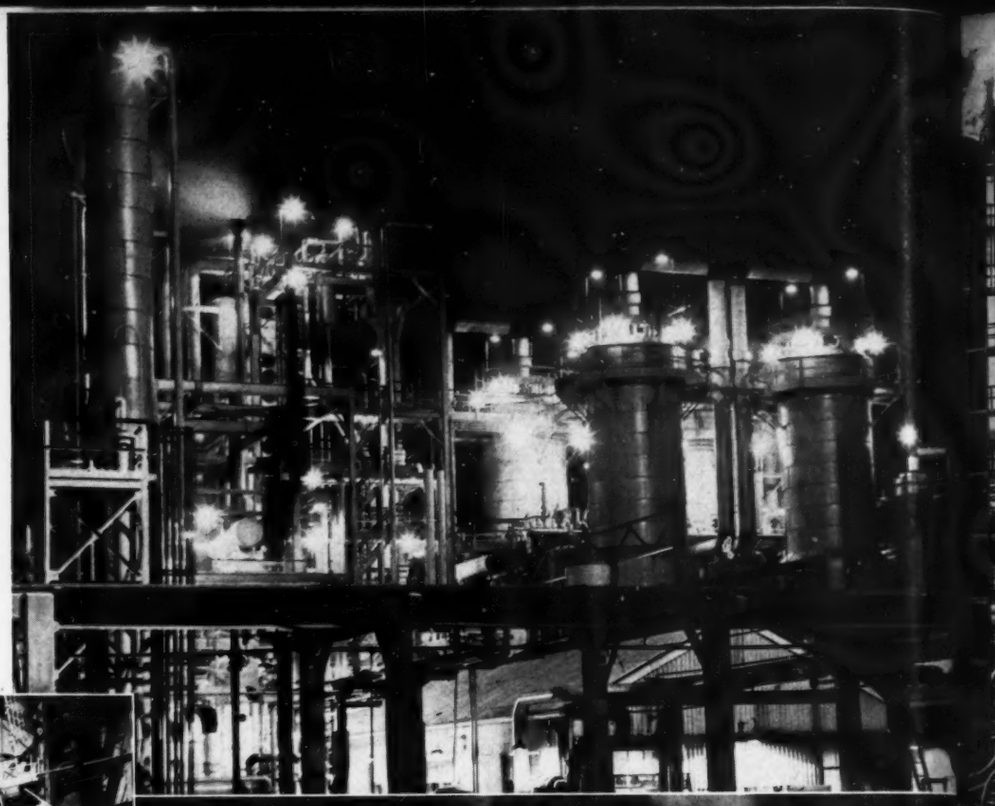
1st, National gas rationing—21st, Work begun on eastern leg of Big Inch—Tank cars frozen in eastern service—31st, First oil pumped into Big Inch.

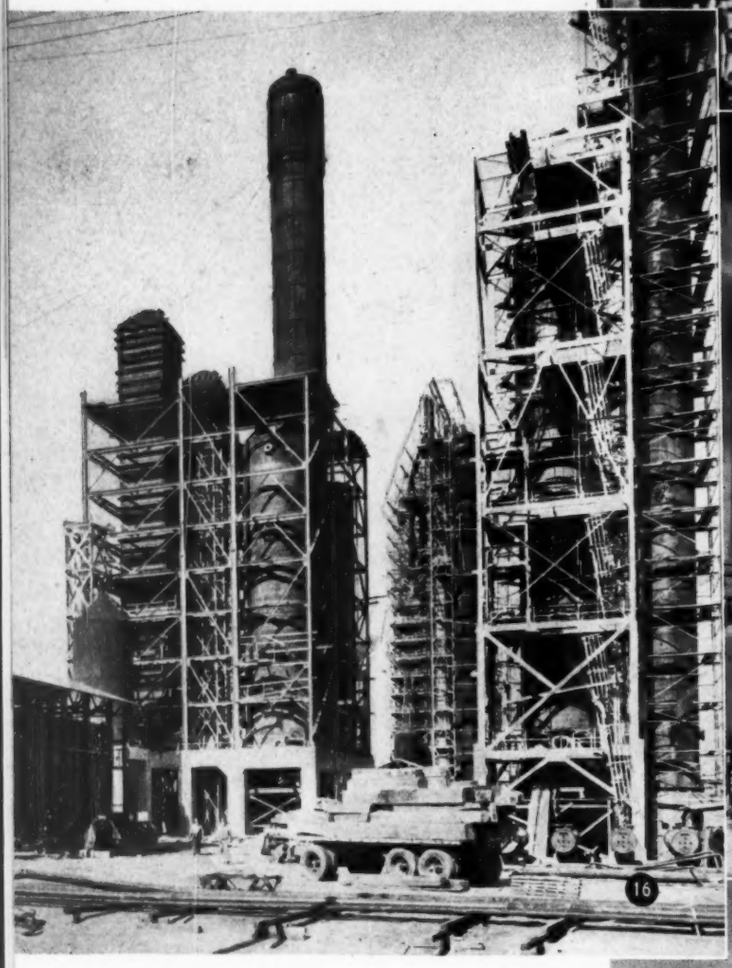
JANUARY 1943

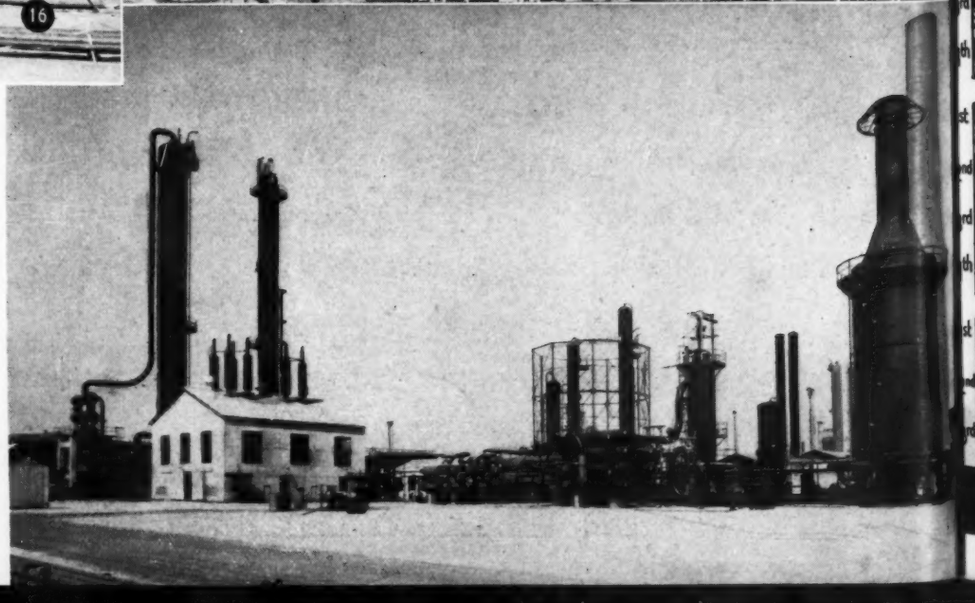
Pleasure driving banned in east as coupons exceed gasoline supply—18th, First east coast catalytic cracker dedicated at Bayway, N. J.—33 scheduled for 1943—Houdry announces new "adiabatic" catalytic cracker—Service station sales reduced to 72 hours per week—PAW approves Little Big Inch.

FEBRUARY 1943

Fuel oil rationed in Washington & Oregon —10th, Trans-Florida pipeline completed—WPB approves western leg of Little Big Inch—Rubber vs. 100-octane battle in open at House Military and Naval Affairs Committee hearing—Jeffers stops work on five "quickie" butadiene plants—9th. DFC awards $44,000,000 contract to WEP for western leg of Little Big Inch—13th, First crude reaches Norris City, Ill., through Big Inch.

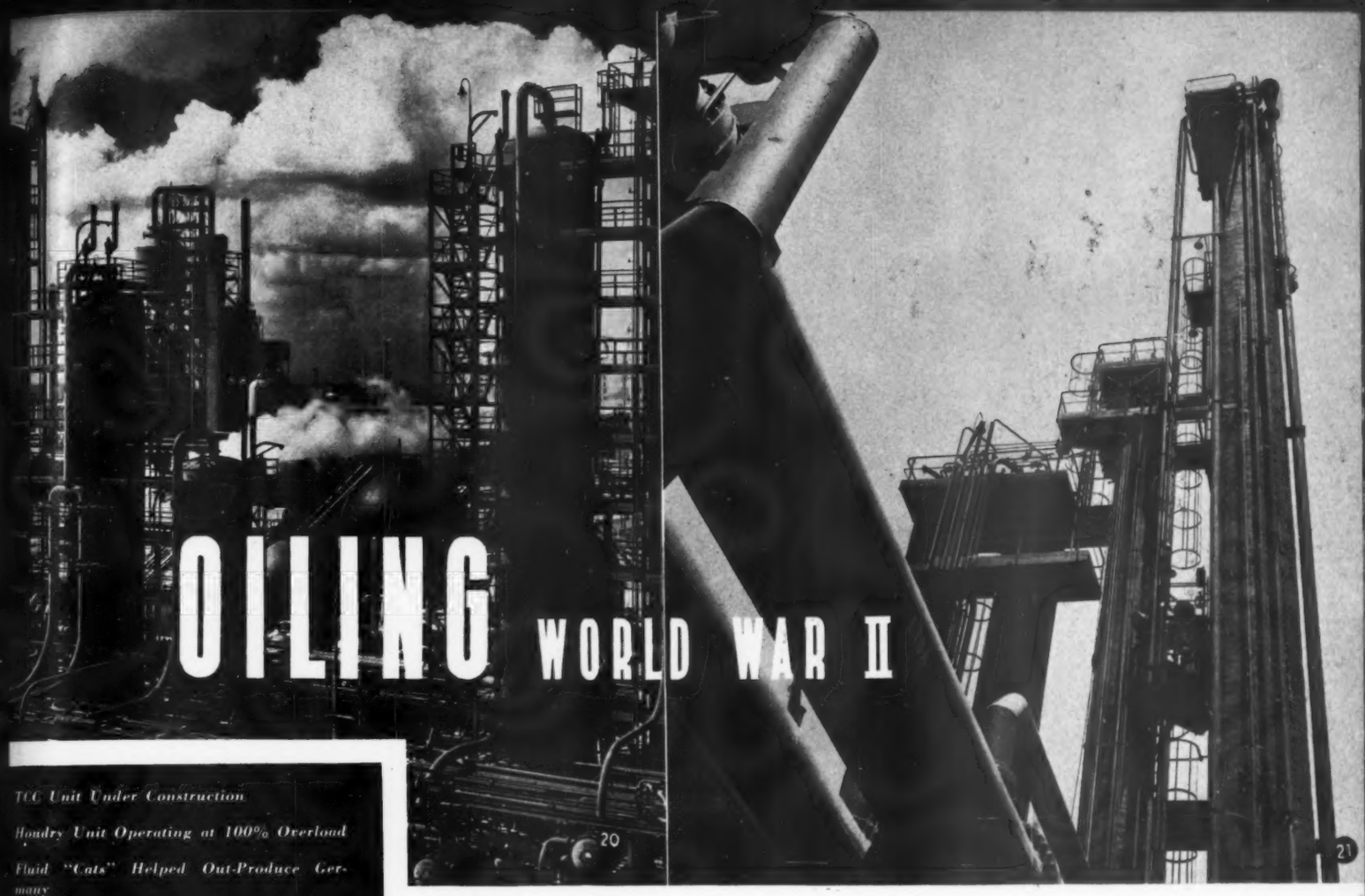






MARCH 1943

Ickes asks industry to drill 4500 wildcats in 1943—Atlantic Refining Company announces development of mass spectrometer—ODT pushes new $1 million tank car unloading rack program —Pan American reverses 224-mile line from Longview to Texas City to feed Big Inch.



OILING WORLD WAR II

TCC Unit Under Construction

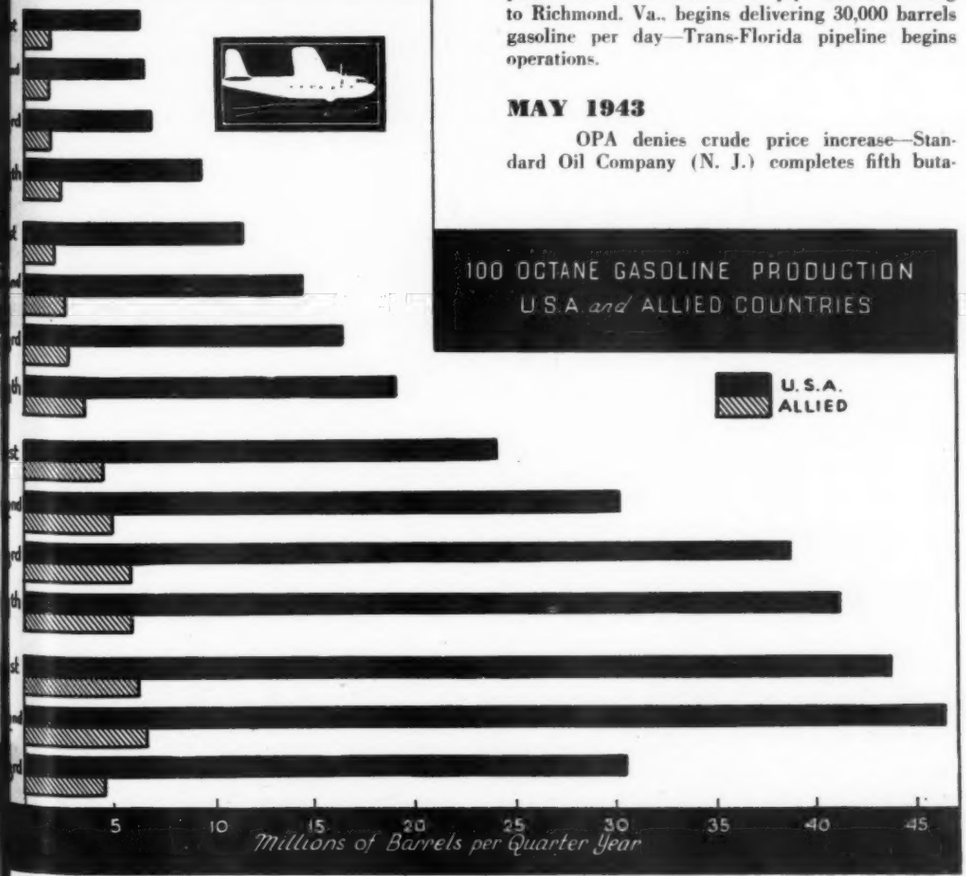
Houdry Unit Operating at 100% Overload

Fluid "Cats" Helped Out-Produce Germany

Hydrogenation, A German Discovery Helped Whip the Nazis

Superfractionators for Aviation Gasoline

Isomerization — A Wartime Chemical Miracle



APRIL 1943

WPB approves Little Big Inch eastern extension—PAW considers Lubbock, Texas to Drumright, Okla. and Chicago to Toledo pipelines—Ickes recommends 35¢ crude hike—Manpower shortage in industry becomes critical—15th, Standard Oil Company (N. J.) offers Buna rubber patents to U. S.—Plantation pipeline eastern leg to Richmond, Va., begins delivering 30,000 barrels gasoline per day—Trans-Florida pipeline begins operations.

MAY 1943

OPA denies crude price increase—Standard Oil Company (N. J.) completes fifth butadiene plant at Baton Rouge—Cities Service to build 26-inch gas line from Hugoton field—Fifteen sea-going tankers constructed in May.

JUNE 1943

OPA cuts B & C ration coupons in twelve northeastern states from 3 to 2.5 gallons—Sinclair completes 6-inch products line from Schaefferstown, Pa., to Baltimore and Washington—473 barges, 100 tugs and 21 river towboats under construction—Railroads haul 1,060,744 barrels per day of oil to east coast.

JULY 1943

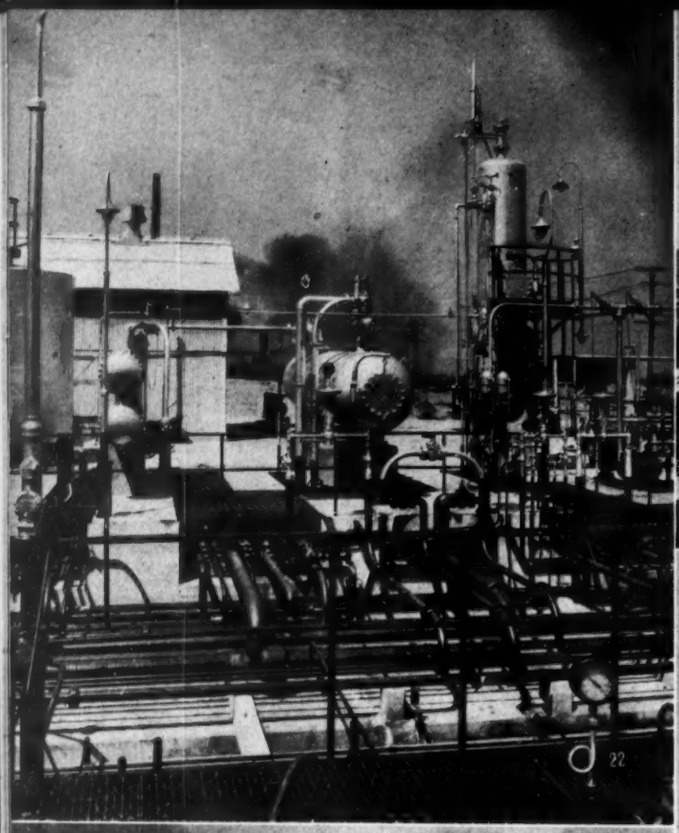
Formal opening of 30,000-ton rubber plant at Baytown, Texas, first Texas plant to be completed—100-octane plants assigned AA1 priority rating—14th, First crude pumped into eastern leg of Big Inch.

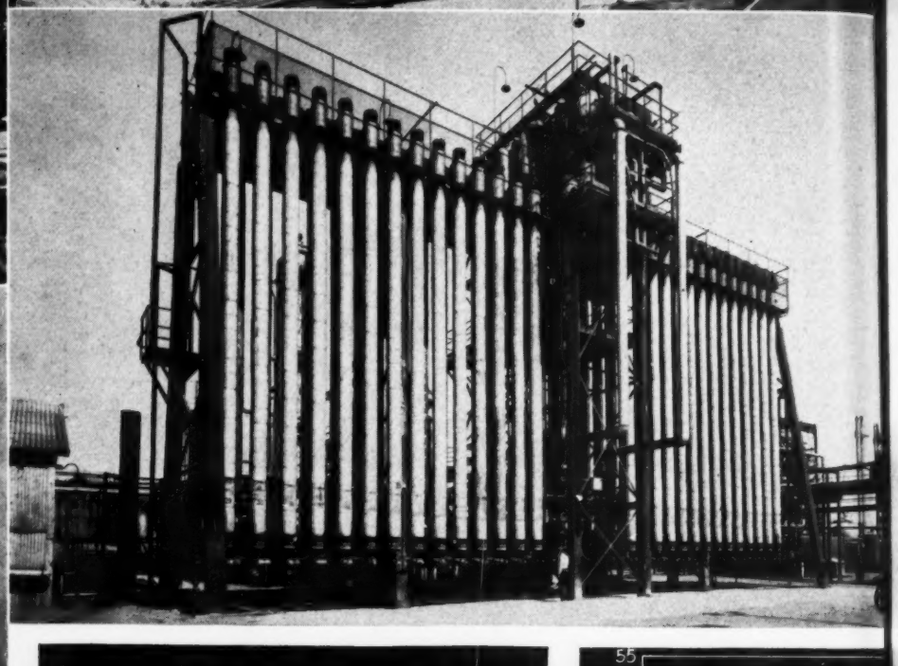
AUGUST 1943

14th, First crude reaches Phoenixville through Big Inch—16th, Mid-western and southwestern A B and C coupons cut to 3 gallons—Many pumps in east dry—Texas Company puts $6.8 millions toluene plant on stream at Lockport—Port Neches 120,000-ton rubber plant completed (third in Texas).

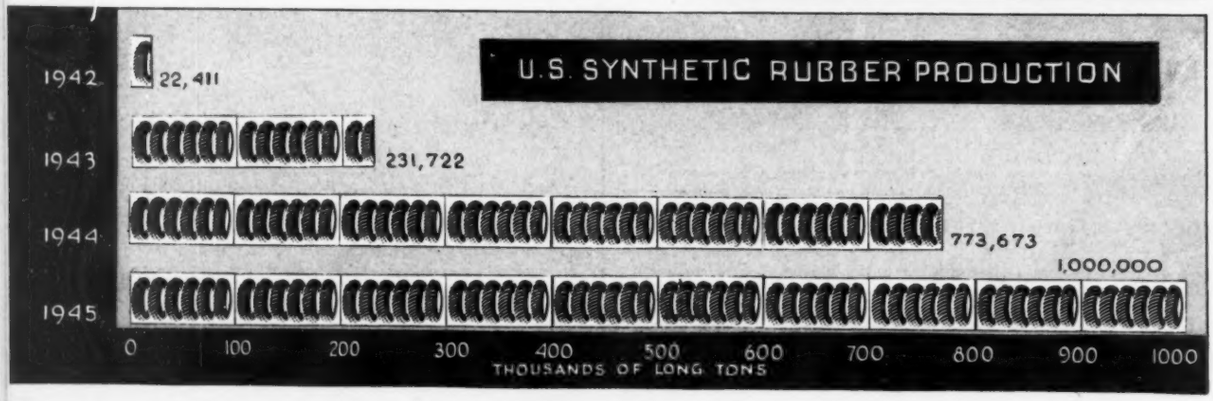
SEPTEMBER 1943

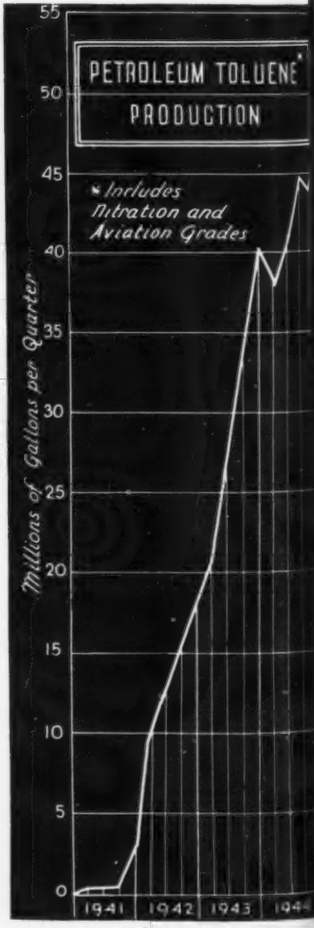
W. R. Boyd, Jr., chairman of PIWC, reports on results achieved by Technical Advisory Committee in increasing 100-octane production.





22. *Alkylation an Important 100-Octane Step*
23. *Butadiene Plant for Synthetic Rubber*
24. *Petroleum Toluene for Bombs*
25. *Cumene, an Unprintable Word Early in The War*
26. *Pipelines By Air*
27. *Gasoline From Ship to Shore*
28. *Portable Lines Went Anywhere*
29. *2000 Miles From Calcutta to China*
30. *Portable Pump Station*
31. *Fill 'Er Up*
32. *Americanized Italian Landscape*





OCTOBER 1943

12th, Rocky Mt. and Pacific coast A coupons cut from 4 to 3 gallons—19th, PAW Directive No. 75 limits use of butanes where isobutane content exceeds 20%—Test water pumped into Little Big Inch at Beaumont—Refiners turn to West Texas sour crude to meet war demands—Economic Stabilizer Vinson says no crude price increase.

NOVEMBER 1943

Premium gasoline octane cut to 76, regular to 72—3rd, Rubber Director Bradley Dewey reports rubber program 76% complete—PAW asks industry to drill 24,000 wells in 1944—18,000 wells drilled in 1943—17% of wildcats successful—30th. Standard Oil Company of New Jersey dedicates $14,000,000 catalytic cracker at Baltimore.

DECEMBER 1943

Final weld made in Little Big Inch 225 days after construction began.

JANUARY 1944

7,000,000 ft. of drill pipe to be needed to drill 1944 wells—Twelve more 100-octane plants to be completed before February 15, another twenty-four by April 15, leaving only fifteen for later completion in 1944—43 plants now in operation, nine completed since Nov. 1, 1943—10th. Canada's 38,000-ton synthetic rubber plant at Sarnia goes on stream.

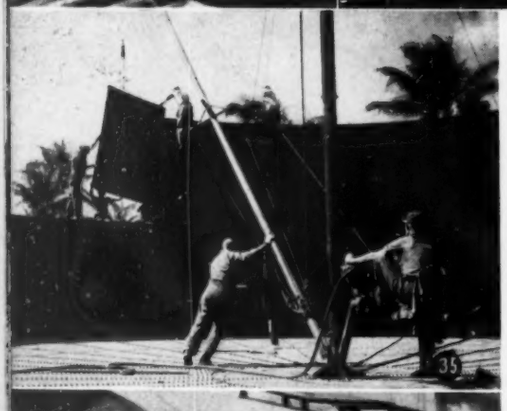
FEBRUARY 1944

Aviation plants put on priority par with landing craft—Refined products reach Norris City, Ill., in Little Big Inch—Kerosene shipment in boxcars resumed to alleviate eastern shortage—PAW wants 1800 rotary rigs running in 1944—23rd, Neches Butadiene plant on stream—Lend lease oil shipments to Feb. 29th total $743 millions—Crude subsidies for stripper wells proposed—Government-sponsored Petroleum Reserves Corporation announces it will build 1250 mile pipeline from Persian Gulf to Mediterranean.

MARCH 1944

Big Inch transported 88,000,000 bbls. crude in first year of operation—Middle East pipeline proposal creates uproar in oil industry—API reports crude reserves reduced 18.6 million barrels in 1943 to 20 billion barrels—Post-war conversion of Big Inch to gas line suggested—First refined oils reach east coast through Little Big Inch—PIWC blasts PRC and Arabian Pipeline proposal—Independent producers appeal to President for increase in crude price.

OILING WORLD WAR II



33. *Jerrycans by the Thousands*
34. *Patton's Tanks Were Fueled and Oiled*
35. *Aviation Storage on Guam*
36. *Supplementing the Pipeline in France*
37. *The B-29, Conqueror of Japan*
38. *100-Octane Ready to Go*
39. *Jet Propulsion Takes 'Em Up*

APRIL 1944 . .

Industry asked to produce 4,725,000 barrels per day of crude in April, a new high—Pipeline shipments of sour West Texas crude to Oklahoma begun—Manpower shortage keeps drilling operations below desired level, hampers refining—Black market threatens gasoline coupon rationing system.

MAY 1944

100-octane production up to 400,000 barrels per day—Helium production meets military needs—275,000 bbl. batch of 100-octane moved through WEP to east coast.

JUNE 1944

Natural gasoline and condensate production reaches 300,000 barrels daily—Senate approves $8 millions for synthetic fuel program—Cities Service dedicates Lake Charles refinery, built complete during the war.

JULY 1944

150 units of the 100-octane building program are complete, 39 still are under construction—War demand is depleting stocks of crude and refined products—Defense Supplies Corporation authorized to pay subsidies up to 35¢ per bbl. to producers of stripper wells beginning August 1st—Oil producing companies leasing lands along the Atlantic seaboard as far North as the Connecticut River Valley—100-octane production passes 500-000 barrels daily.

AUGUST 1944

8th, Anglo-American oil pact signed by Acting Secretary of State Stettinius and Lord Beaverbrook—API cancels November meeting—Germany draws heavily on reserve stocks as oil plants badly damaged by systematic 1000-plane bombing raids.

SEPTEMBER 1944

Industry asked to produce 5,051,000 bbls. of crude daily in September—PAW asks for greater production of 80-octane all purpose gasoline with no cut in 100-octane output—100 rigs running in West Edmond pool—481 geophysical and core drilling crews hunting new oil.

OCTOBER 1944

PAW projects 27,000 well drilling program for 1945—Superfuel ready for B-29s and fighters in Pacific—Anglo-American oil pact under fire from industry—More than 1800 rotary rigs running in U. S.

NOVEMBER 1944

Gas pumped into 1256-mile Tennessee Gas and Transmission Company line will alleviate eastern fuel shortage—Inland waterways carrying 1,475,000 bbls. of oil daily—Two Texas synthetic rubber plants equal output of 28 million trees—Army reveals building of India-China pipeline.

DECEMBER 1944

240 tankers delivered by American shipyards in 1944—Industry comes close to 24,000-well goal set by PAW.

JANUARY 1945

ICC imposes high demurrage rates to speed tank car loading and unloading—50,761 tank cars in eastern service move slowly because of severe storms, supplies 75,000 bbls. below rationed demand—Commercial process for producing 5-cent gasoline from natural gas announced—Anglo-American oil pact withdrawn from Senate for renegotiation.

FEBRUARY 1945

Campaign for higher crude prices reopened—New $37 million rubber plants approved for construction—U. S. crude reserves increase 389,000,000 bbls. in 1944 to 20,453,231,000 bbls. despite war demand.

MARCH 1945

PAW proposes construction of five additional 100-octane refineries to cost $78,000,000—Canol pipeline project abandoned by War Department—Carbon black shortage hurts tire production, new plants rushed to supply 100,000,000 lbs. monthly need.

APRIL 1945

New toluene plants ordered to supply stepped up bombing needs—Hugoton to Detroit gas line proposed—$6.7 million aviation gasoline plant for Curacao approved—Ickes to stay in Truman cabinet.

MAY 1945

9th, V-E Day—Synthetic fuel research program cut in half to $6 millions by Congress—Shell to build $48 million refinery in Venezuela—Elk Hills Naval Reserve beats schedule to reach maximum output with 236 wells—World's longest pipeline now operating, 2,000 miles from Calcutta to China—Military needs for fuel oil in Pacific exceed total for all fronts before V-E Day.

JUNE 1945

U. S. crude production at new peak of 4,868,000 bbls. per day—Venezuelan production up 36 percent—22nd, "A" coupon value increased to 6 gallons—Automobile industry permitted to produce 200,000 cars in last half of year—Revised Anglo-American oil pact ready for re-submission to British—Iraq Petroleum Company places orders for 120,000 tons of pipe for $50 million line from Kirkuk to Haifa—PAW asks 10,000 bbl. increase in West Texas sour crude production.

JULY 1945

Synthetic tires now giving service up to 40,000 miles—Labor disputes slowing supplies of oil products—American technologists study German synthetic rubber and oil industries—American army wore out 900,000 tires in eleven months between D-Day and V-E Day—U. S. plans 1.2 million ton production of synthetic rubber in 1946—Equipment controls relaxed to permit more oil industry construction—U. S. crude production nears 5,000,000 barrels per day—New techniques speed unloading of tankers in Pacific war zones.

AUGUST 1945

Ickes predicts worst fuel shortage coming—Tank car haul limit reduced from 200 to 80-mile radius—14th, V-J Day.

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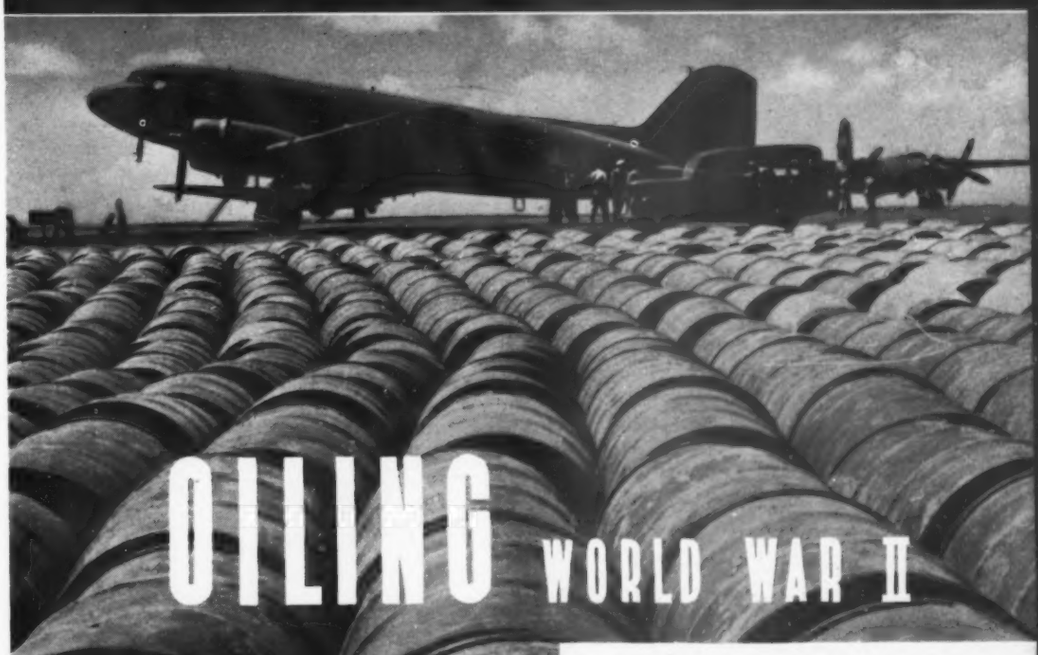

OILING WORLD WAR II

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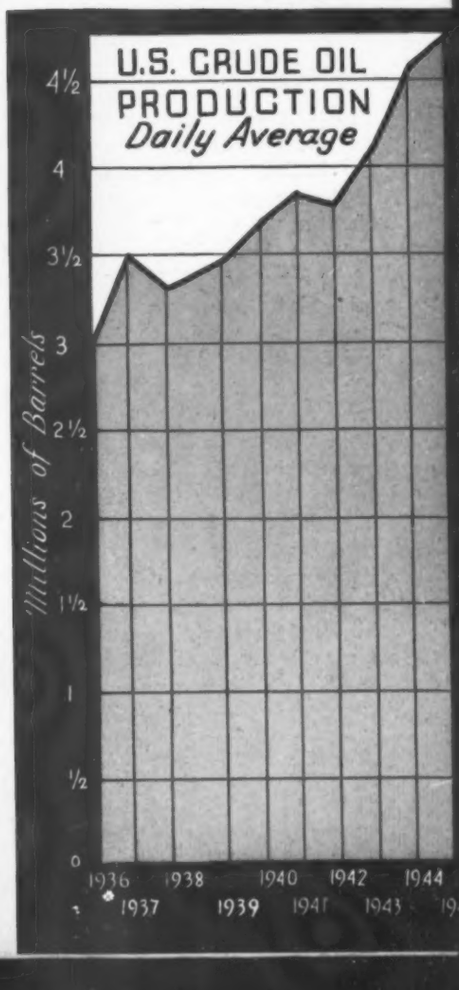


CARIBBEAN REFINERIES WERE CLOSELY GEARED TO ALLIED WAR OPERATIONS

Four Plants of Royal Dutch Shell Group Raised Crude Throughput to 330,000 Barrels Daily — New Processes and Equipment Enabled Giant Curacao Refinery to Supply Large Flow of High Octane Gasoline, Navy Combat Fuel and Other Products for Use of Armed Forces

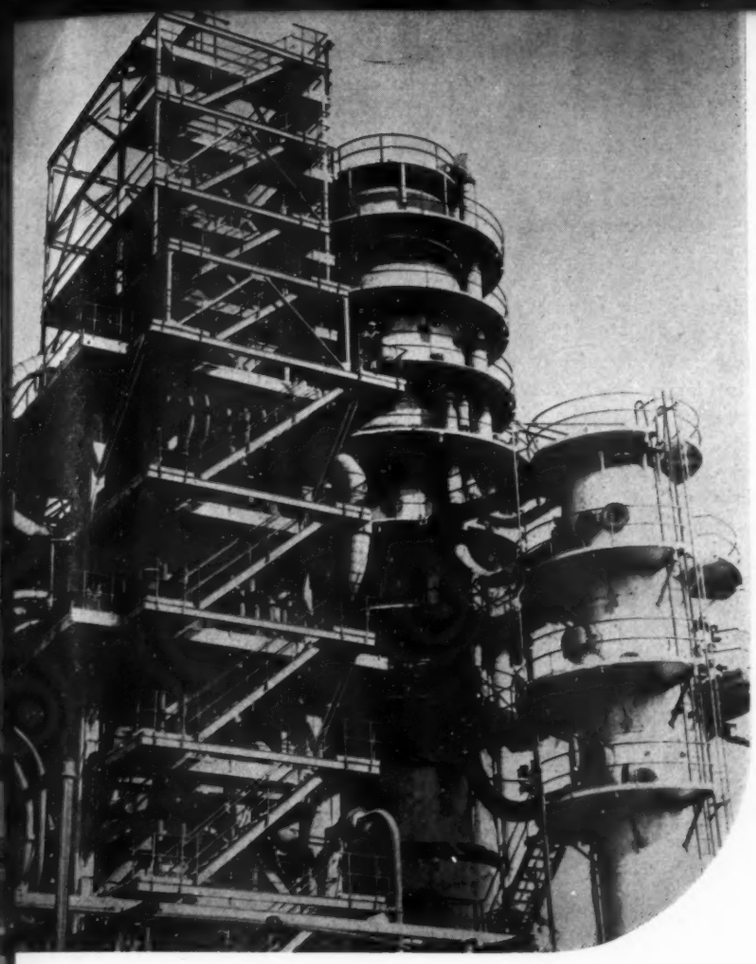
Crude Oil Topping Unit

AS the producer of 65 percent of the world's oil supply the United States naturally played the leading part in providing the petroleum products required to sustain the military operations of the United Nations in the war just ended. As high military authorities and officials of the Petroleum Administration have repeatedly acknowledged, however, an essential factor in meeting these wartime needs was the output of refineries located in the territories of other nations in the Allied group. By far the largest contribution from these sources was made by refineries in the Caribbean area led by the giant plants in the Netherlands West Indies and backed up by the smaller installations in Venezuela. Though prevented by lack of transportation from operating at full capacity during the period when the enemy submarine menace was at is height these plants were processing more than 700,000 barrels of crude daily during the latter part of the war and practically all their products were going to Allied fighting forces.

For reasons of military security information regarding operations in the Caribbean was completely restricted while hostilities continued. Actually from the date when the United States entered the war the facilities of these refineries were placed at the disposal of Allied military authorities. Specialized equipment and processes were installed for the production of high octane aviation gasoline, motor gasoline for the ground forces, combat fuels and Diesel oils for the Navies and tractor fuel to sustain the vastly increased agricultural activities of the United Kingdom. The entire integrated operation of this refinery group was closely geared to the war effort under the direction of government sponsored committees in London and New York representative of refinery managements, which acted as channels for transmitting information concerning requirements as determined by governmental agencies. Throughout the war period the rate of crude throughput, the division of output between critical military demands and less essential civilian allotments, the addition of new facilities designed to increase production of war materials — all were governed by military policies expressed through designated agencies with which the oil industry cooperated.

For many years before the war one of the world's largest refineries was that of the N. V. Curacaosche Petroleum Industrie Moatschappij on the island of Curacao, largest of four plants operated by the Royal Dutch Shell Group in the Caribbean area, the others being located on the island of Aruba, in Trinidad and at San Lorenzo in Venezuela, with a present-day daily throughput of over 300,000 barrels of crude, a figure which was exceeded during the final stage of the war due to concerted efforts to meet the rising requirements of the Allied fighting forces.

First put into operations twenty-seven years ago the Curacao refinery grew by successive enlargements to be one of the top-ranking refineries of the world. It produces a wide range of petroleum products, including aviation gasolines, motor gasolines, kerosenes, diesel oils, gasoline, fuel oils, lubricating oils, solvents, asphalts and naphthenic acids. Its storage and tanker loading facilities are



Dubbs Cracking Unit 15.

located at Emmastad, Caracas Bay and Bullen Bay. Drydocks and ship repair equipment are located at Koningsplein on Schottegat Bay.

Manufacturing facilities at Curacao include crude oil topping, sharp fractionation equipment for recovery of isopentane and butanes from straight run gasoline, high vacuum distillation of reduced crude oil for lube oil manufacture. A large percentage of reduced crude oil is thermal cracked and heavy straight run naphtha reformed in conventional thermal reform plants. The cracked and reformed gasolines are acid treated, redistilled and finished in doctor treating facilities. The cracked gases after separation are processed in U. O. P. selective polymerization, isomerization, alkylation and cumene manufacturing facilities. The refinery is equipped with drum and can manufacturing units.

In addition to the production, throughout the war years, of substantial quantities of 87-octane aviation gasoline, the production of 100-octane aviation gasoline was increased from zero at the outbreak of the war to a level of from 11,000 to 12,000 barrels daily during the months immediately preceding V-J Day. This increase in the output of a highly critical munition of war has been achieved not only by the addition of specialized auxiliary refinery equipment but by the application of three new processes, invented and developed in the laboratories of the Royal-Dutch Shell Group organization.

The first of these is the Avaro process, which was the first successful thermal cracking process developed for the manufacture of an aviation blending agent. The importance of the development of this process was that it was carried out in existing reforming units and, therefore, needed the addition of no specialized equipment during a time when the various contributors to the war effort competed keenly for the available supply of construction materials.

The process results in the production from a crude naphtha cut of a highly aromatic aviation blending agent permitting a reduction in the total alkylate content of the 100-octane aviation blend and the incorporation of lower octane base stocks. Since the limitation on the production of 100-octane aviation gasoline was generally the supply of light alkylates, the importance of this process will readily be appreciated and, in fact, it generally resulted in a production of 100-octane aviation gasoline disproportionately larger than the quantity of blending agent incorporated.

The second innovation was a combination of new construction and a new process — the erection of a plant for the synthesis of the high octane gasoline blending agent, cumene. This plant was the first to be operated using sulphuric acid as a catalyst.

The third development was in the realm of alkylation and consisted of the alkylation of the light pentane/amylene fractions from cracking and reforming operations which made possible the subsequent recovery in the limited capacity available of the entire iso-pentane content for inclusion in the 100-octane aviation gasoline blend.

Of an apparently less critical nature, but of considerable fundamental importance, was the supply of tractor fuel to the United Kingdom. The necessity of obtaining optimum food production in the United Kingdom called for a large increase in the use of tractors. These tractors in many cases had to be handled by inexperienced operators and this factor necessitated the supply of a high-quality fuel which would permit, as far as possible, trouble-free operations. Such a high-quality fuel was not readily available in the large quantities required and for a period practically the entire United Kingdom requirements were provided from Curacao refinery, the output being allowed to dimish only when alternative sources of supply were able to be developed.

Another major munition of war which Curacao was called upon to supply in large quantities was fuel oil of the low viscosity combat type for the Allied navies. The growing demand for this type of fuel in the place of the conventional high viscosity residues from Venezuelan crudes necessitated the adoption of refining methods radically affecting the normal operations of the refinery. The importance attached to the output of maximum distillate products already had dictated the incorporation in the crude stream of a greater proportion of high gravity crudes. An ancillary effect was the production of appreciable quantities of low viscosity residues from such crudes. Every effort was made, and with considerable success, to develop and expand the Royal Dutch Shell Group's own light crude resources; and, in addition important quantities of light crudes were acquired from other producing companies for transport to Curacao and incorporation in the refinery throughput. This measure, however, was not adequate to provide the large quantities of thin fuels required and recourse was made to the expedient of asphalt dumping, not only to allow the production of the light products from the crude without excess production of heavy residual fuels, but also to provide the essential quantities of diluent for the lowering of the viscosities of the heavy residues to the desired viscosity of combat fuels. This process of asphalt dumping consists of the vacuum distillation of heavy cracked residues, the recovered distillates here being utilized for the manufacture of diesel oils, and for fuel thinning. The hard asphalt is discarded. This process, during the years of the war, was applied to the extent of a total discard of some 11,000,000 barrels of hard asphalt.

By means of all the measures taken the deliveries of thin combat fuels from Curacao approached the unprecedented volume, for a single refinery, of 5,000,000 barrels monthly in the closing days of the Pacific war.

Attending these major activities of the refinery has been the ancillary production of subsidiary products in the form of naphthenic oil residues and reduced petroleum ashes of high vanadium content. Substantial quantities of naphthenic oil residues have been extracted from the kerosene and gas oil fractions and made available for war industries. A particularly important application of this product is as a base for the highly efficient rot-proofing material for wood and canvas, utilized in the manufacture of service equipment, particularly where designed for use under the extreme conditions of humidity in the far eastern war zone.

As regards vanadium, its presence in small proportions in fuel oils of Venezuelan origin has long been known; however, since vanadium is a metal used in the hardening and toughening of steel required for high-speed cutting tools, armored warships and tanks, the manufacture of guns, motor vehicles and locomotives, forgings and springs, its production became critical with the advent of the war. A process has been developed by the Royal Dutch Shell Group for the greater recovery of vanadium as a wartime measure, through the collection of deposits from oil fired boiler plants, refinery furnaces and ships. In the five years from 1940 to 1944 the Group's contribution of vanadium recovery from fuel residues totaled 323 tons, making possible the production of some 85,00 tons of special steel.

Apart from the change in the emphasis on certain products of critical war importance, the demands of war have necessitated a constantly increasing level of crude oil throughput. Normally, by good operating practice, the plant is geared to run at about 230,000 bbl. per day. As a result of pressure arising from the urgently increasing demands of the Allied war machine, the throughput was raised to about 280,000 bbls. This essential increase in throughput was made possible only by careful study of the operation of each individual distillation unit, increasing allowable throughput by the recovery from the crude of only the lower boiling fractions useful in the manufacture of aviation and motor gasolines while leaving in the residues for incorporation in combat fuels, the necessary diluent.

The increase in crude oil throughput has been effected despite the inevitable strain of wartime operations, notably the depletion of personnel, and has constituted a considerable burden on the personnel remaining and responsible for operations. Not only has there been a large increase in throughput but the critical shortage of ocean-going tanker tonnage has necessitated constant preoccupation with the fastest possible turnaround of ships either discharging crude oil or loading out products. Furthermore, with the increased movement of crude oil from Lake Maracaibo, there has been a considerable strain on the staff and crews of the fleet of shallow draft tankers, designed for the carriage of crude from lake ports to the Caribbean refineries, resulting from the necessity for operating in accordance with accelerated schedules to make the most effective use of the limited transportation capacity available.

Despite all these difficulties and the mounting strain of continued operations at peak level, the history of Curacao's operations during the war years has been one of ever-increasing endeavor and achievement, characterized by the record level of operations achieved in the closing days of hostilities when all resources were being mobilized to the limit to bring maximum pressure to bear upon the foe in the Pacific.

The San Lorenzo refinery on Lake Maracaibo, Venezuela, normally is operated principally for local market requirements, surplus products being exported. In 1939, before the outbreak of the European war, the average intake of this refinery was 19,200 barrels daily. Progressively, during the war years, it was found necessary to put into effect all unused refinery capacity in the Caribbean to meet the expanded product demand and in step with this need the throughput of the San Lorenzo refinery was increased in the latter months to full capacity of 38,000 barrels daily.

In 1939 the average intake of the Arend refinery on Aruba island was about 5,000 barrels daily. At the end of 1942, in the light of circumstances then prevailing and in the overall interest of the Caribbean refinery operations, the plant was shut down and remained so until March 1945. At that time product requirements of the United Nations had changed to the extent that they demanded the reopening of the refinery, which then operated on an increasing throughput.

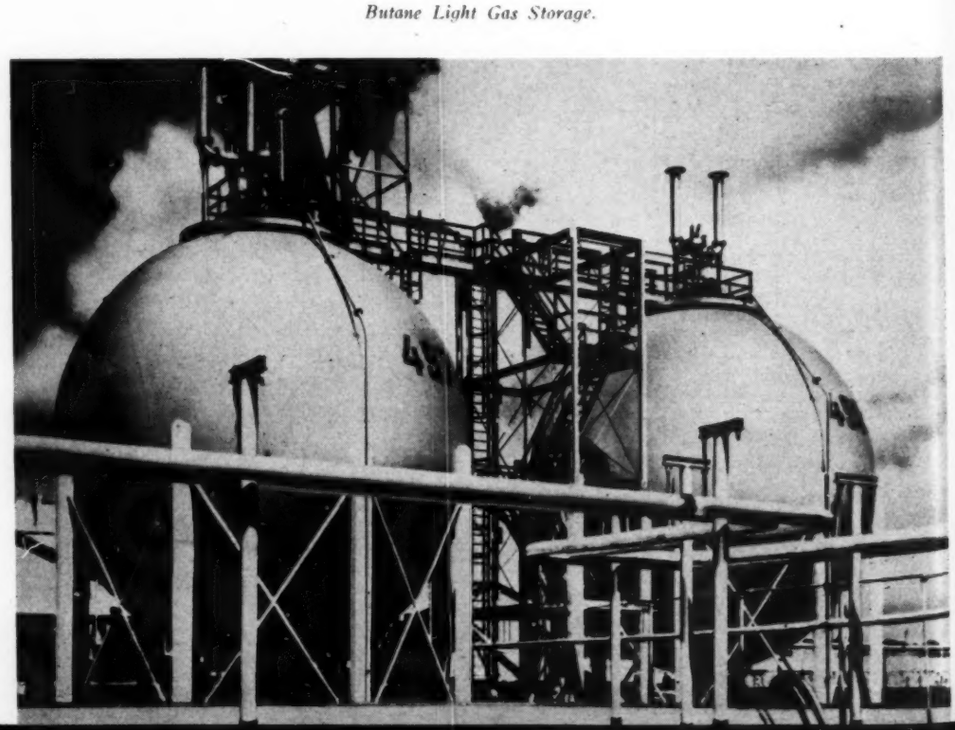
The refinery of United British Oilfields of Trinidad at Fortin, Trinidad, has been operating throughout the war period at maximum capacity within the framework of the overall United Nation's program of requirements. Refinery runs increased from 18,500 barrels daily in 1939 to 25,000 barrels daily. Modifications were made to one distillation unit in order that asphalt for export and for the United States Naval Base in the Trinidad area could be manufactured. A rearrangement of the plant was made to facilitate the manufacture of the vitally needed war product, nephthenic oil residue, production of which has varied between 50 and 70 tons monthly.

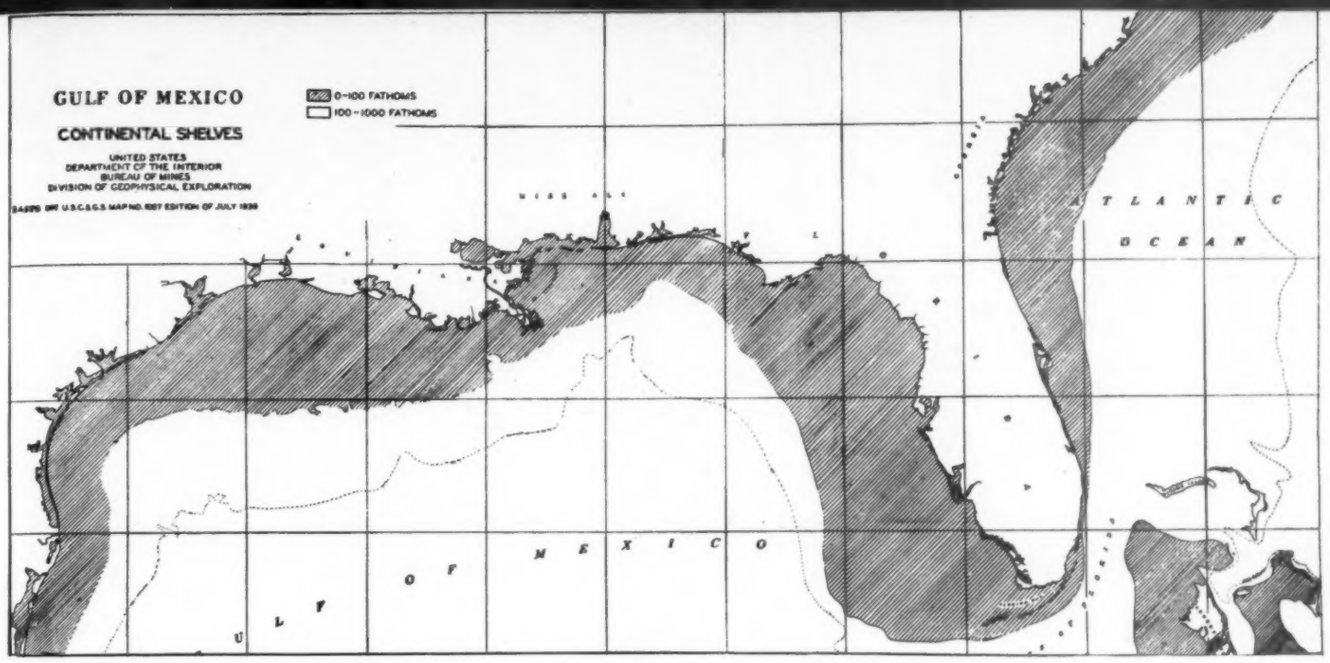
A feature of the wartime operations of the Trinidad refinery has been the enormously increased volume of bunker deliveries, which has thrown a heavy burden on both facilities and personnel.

The principal future expansion planned in the Caribbean area by the Royal-Dutch Shell Group is the erection of a refinery at a site near Punta Cardon in the southwestern part of the Paraguana peninsula of Venezuela. The plant, to be built at an estimated cost of well over Bs 150,000,000 will be a complete refinery, with a throughput capacity in excess of 40,000 barrels per day and ample cracking and auxiliary facilities, including provision for the manufacture of aviation gasoline and lube oils. The refinery will have adequate terminal and leading facilities, housing accommodation for employees, hospital, sports ground and recreational facilities. Certain preliminary survey work has been undertaken at the site, and work on temporary camp facilities, is already underway.

While everything possible is being done to expedite the construction of the refinery, the existing materials situation is the controlling factor and it is recognized that considerable time must elapse before materials become available, not only for construction of the refining plant proper but also for its auxiliary facilities.

Butane Light Gas Storage.





GEOLOGIC SURVEYS ARE PLANNED FOR CONTINENTAL SHELF

WASHINGTON

THE Continental Shelf, that submerged region extending in some cases for 100 miles from our shores and all the way from Maine to Texas, and California to Alaska, over which President Truman asserted jurisdiction in his proclamation of September 28, is one of the great unexplored areas the Geological Survey has had its eyes on for a long while. "It may be", Secretary of Interior Ickes once said, months before the Presidential action was taken, "that this Shelf contains more riches than this country has ever dreamed of. It has already been demonstrated that there are rich oil deposits beneath the water off the coast of California and in the Gulf of Mexico. If we are given the 'go' sign by Congress, we propose to explore these water regions for oil and for other minerals".

Now, Mr. Ickes has the "go" sign from the President at least, for with the proclamation was an executive order reserving and setting aside the resources of the Shelf and placing them for administrative purposes, pending legislation by Congress, under his control. And the Secretary has asked the Geological Survey to make recommendations for a survey of the submerged area which is more than 750,000 square miles in extent.

Geological surveys of submerged areas, they point out, have already been satisfactorily made by seismic methods, and other methods are also available. One private company has made a systematic seismograph survey to a distance of 26 miles off the Louisiana coast. Methods suggested for surveying the Shelf include:

Magnetic surveys, which can be made rapidly from airplanes and which can furnish information on the magnetic properties of sub-sea formations and aid in the recognition of structural features;

Gravimetric surveys, made on the sea bottom, in submarines, which would locate salt domes;

Refraction seismic surveys, made from boats and barges and instruments placed on the sea bottom, which will locate shallow salt domes and shallow beds for establishing stratigraphic reference planes;

Reflection seismic surveys, made from boats or instruments on the sea bottom, which will locate deep salt domes and major structural features associated with oil deposits.

Department experts say that while the Continental Shelf in the Gulf of Mexico offers greatest present promise of oil-bearing structures, there may be additional areas off the Pacific Coast with promise of oil, and there are indications that oil-bearing structures might be found off Alaska. There is a strong possibility, they say, that oil-bearing strata may extend as far as 100 miles into the Gulf of Mexico. "From studies already made," the scientist say, "the broad geologic relations of the area indicate that salt plugs and suitable traps associated with them are present at least as far out on the submerged shelf of Texas, Louisiana, and Mississippi as submarine drilling is likely to be feasible in the predictable future."

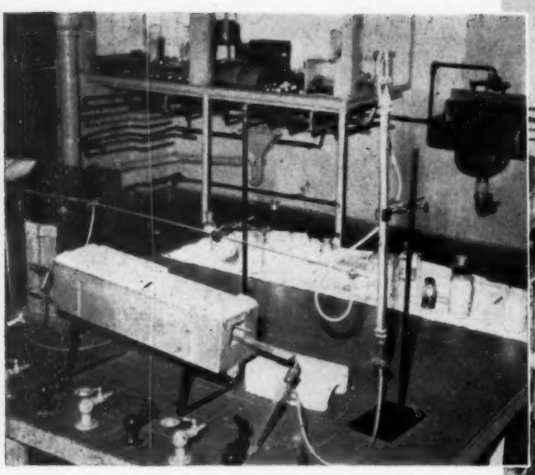
According to the general acceptance of the term — and this is what the President followed in his proclamation — the Continental Shelf is considered to be the submerged land contiguous to a continent and covered by not more than 100 fathoms (600 feet) of water. On the East Coast of the United States from Cape Hatteras north this off-shore shoulder of land out to the 100-fathom depth ranges from 60 to 250 miles in width. South to Florida it is from 40 to 60 miles wide, although near Miami it is reduced to about 20. Along the coast of the Gulf of Mexico the shelf is wider and that part of it contiguous to United States territory has an area of some 149,000 square miles.

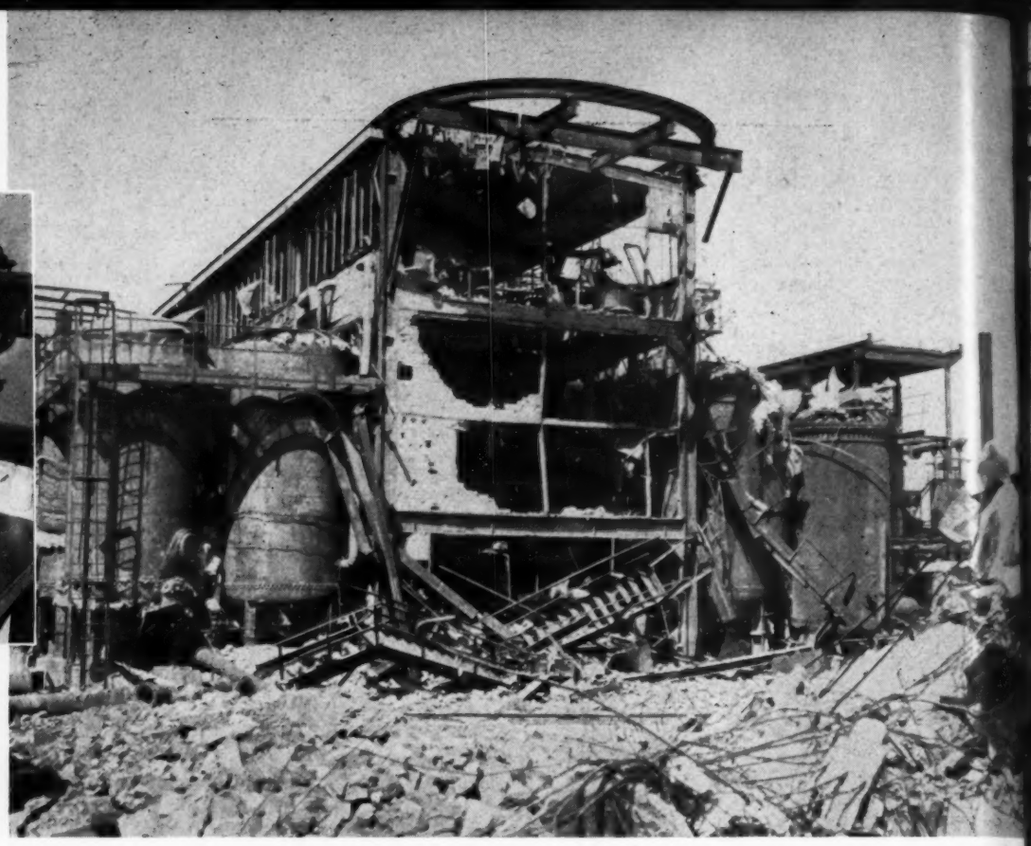
Along the Pacific Coast the shelf is more narrow, averaging approximately 25 miles in width and varying from one to as many as 50 miles. Off Alaska the shelf widens considerably and under the waters of the Behring Sea extends for several hundred miles.

The President's action in asserting jurisidiction over the natural resources of the shelf was taken on the recommendation of the Secretary of State and the Secretary of Interior. The proclamation declared that the United States considers "the exercise of jurisdiction over the natural resources of the subsoil and sea bed of the continental shelf by the contiguous nation is reasonable and just. The Continental shelf," it said, "may be regarded as an extension of the land mass of the coastal nation and thus naturally appurtenant to it." Its resources "frequently from a seaward extension of a pool or deposit lying within the territory" and "self-protection compels the coastal nation to keep close watch over activities off its shores which are of the nature necessary for utilization of these resources."

A White House statement explained that the policy proclaimed by the President "does not touch upon the question of federal versus state control. It is concerned solely with establishing the jurisdiction of the United States from an international standpoint. It will, however, make possible the orderly development of an underwater area 750,000 square miles in extent."

Congressional reaction came from Representative Hatton Sumners of Texas, chairman of the House Judiciary Committee, which recently put through the lower chamber legislation giving the states title to tidelands. Sumners said the establishment of state boundaries, in view of the proclamation, probably would be up to the courts to decide. Most states claim control out to the traditional 3-mile limit.





Above: Historical F. T. A. Apparatus—Kaiser Wilhelm Institute.

Right: Hoesch Benzine—Fischer-Tropsch Converter House after Bombing.

SCIENTISTS GARNER SECRETS OF GERMAN OIL RESEARCH

By Ruth Sheldon

CLOSE on the heels of G.I.s invading Germany jeeped a team of America's top flight synthetic fuel specialists intent upon learning the secrets of the German synthetic oil industry. The exciting and dramatic story of their discoveries was disclosed in Washington before the O'Mahoney committeee investigating petroleum resources by Dr. W. C. Schroeder, Chief, Office of Synthetic Liquid Fuels, Bureau of Mines, who headed the recently returned team.

The information obtained by Dr. Schroeder's group in their three months investigation beginning in February, coupled with United States research developments in the synthetic fuel field will place America in the position to produce synthetic fuel more efficiently and cheaper than even the Germans were able to do. In fact, if natural petroleum production costs increase and imports of foreign oil are curbed, the establishment of a big synthetic fuel industry in this country will become a commercial possibility.

Two years ago the Bureau of Mines initiated plans for technologists to investigate the German industry as soon as plants and laboratories were captured. The Bureau wished to capitalize upon Germany's 25 years research, involving expenditure of vast sums and operation of commercial plants estimated to produce 30 to 40 million barrels of oil and gasoline annually. Detailed knowledge of Germany's experience would be of great value to the Bureau in directing the expenditure of the thirty million dollars authorized in Congress in 1943 for a five year synthetic fuel research and development program in improvement and development of better processes and would do away with the expenditure of time and effort in catching up with advances made by German and other foreign synthetic fuel industries.

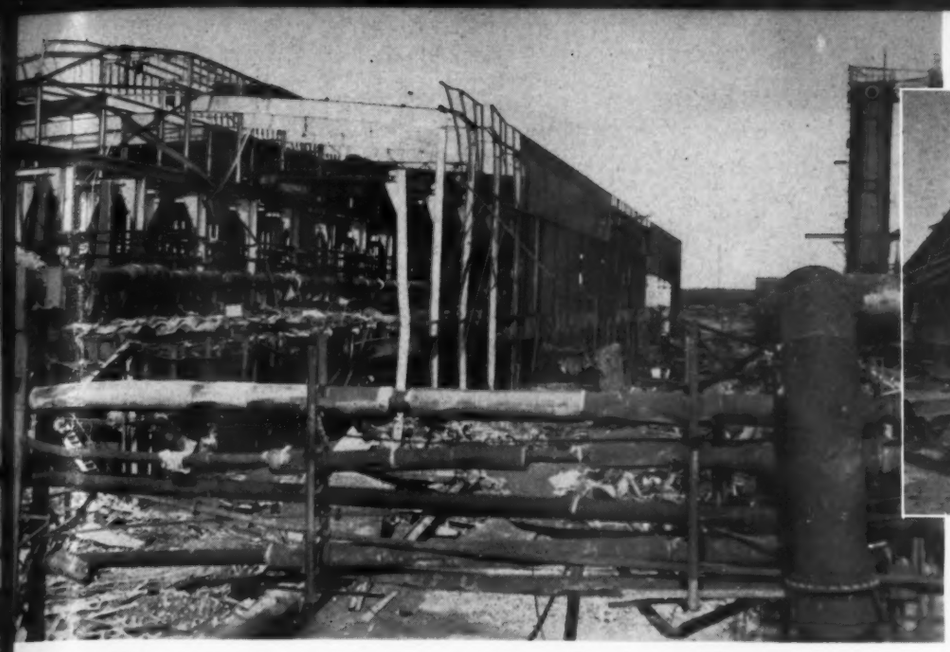
The Petroleum Administration for War was also anxious to participate in such investigations and a combined team of twenty-three Government experts and oil industry specialists arrived in London early this year to prepare for the difficult task. Besides Dr. Schroeder the group included: John G. Allen and Jean P. Jones, Phillips Petroleum Co.; Harold V. Atwell, The Texas Co.; Edward B. Peck and E. L. Baldeschweiler, Standard Oil Development Co.; George S. Bays and Ernest F. Voss, Humble Oil & Refining Co.; Leonard E. Carismith, Standard Oil Co. of Louisiana; Ernest Cotton and Paul K. Kuhne, Gulf Oil Co.; L. P. Evans, Socony-Vacuum Co.; Warren F. Faragher, Houdry Process Corp.; Vladimar Haensel, Universal Oil Products Co.; William A. Horne, Gulf Research and Development Co.; Irvin Harvy Jones and A. R. Powell, Koppers Co.; Byron L. MacKusik and Hans Schindler, Pure Oil Co.; Lester L. Hirst, Louis L. Newman, William W. Odell and Guenther Von Elbe, Bureau of Mines; Horace M. Weir, Consulting Engineer; and D. S. Fraser, Chief, Technical Section, Foreign Refining Division, PAW, on temporary assignment as London representative.

Well briefed on all methods which might have to be employed in locating vital information, equipped with bedrolls, helmets, gas masks and all other war zone necessities, this group waited for its own particular D-day.

Allied armies were advancing rapidly toward the Rhine and the first synthetic fuel plant occupied was in the Krefield area. Two American investigators were flown into Belgium by the British and then taken to the target area across the German border in two armored reconnaissance cars. To their disappointment they discovered the plant was completely bombed out and no production of oil or gasoline had been secured since October, 1944. Study of the severely damaged plant yielded little information.

German plant personnel was rounded up. The majority of the workers were in the area as their homes were there. They were questioned separately so that stories could be compared. Not once did their stories agree. Some were extremely willing to talk; others needed an overnight stay in military prison to loosen their tongues. The most recalcitrant usually succumbed to the argument that if they did not give the necessary information, their life's work might be lost permanently. Documents were found and evacuated for study.

The Wesselling synthetic aviation gasoline plant on the west bank of the Rhine in the area south of Cologne was next occupied by American troops. Here the investigators secured a complete picture of the German commercial process in the production of 90 to 95 octane gasoline, a



Above: Destroyed Gas Holders at Moers-Hamburg Plant.

Left: Moers-Homburg Plant—Fischer-Tropsch Unit.

Ruhr-Chemie—Bombed Alcohol Plant.

product as satisfactory as our own. Since the Germans used injection engines they did not find it necessary to produce 100 octane.

At this plant the investigators ran into an unusual situation. The plant, destroyed by bombing, had not been operating for six months. The investigators were convinced that the German engineer in charge was answering their questions truthfully but at the same time was concealing something important. After persistent, adroit questioning he finally admitted that during his six months enforced leisure, he had prepared a full report on plant design, equipment, operation, purchasing, troubles encountered, temperatures, pressures, catalyst composition and analyses of products. He had buried two copies of this report and was trying to conceal the fact. The investigators supplied him with a spade and the documents he dug up are the most complete story we have on the hydrogenation process. The documents were sent to London to be microfilmed for transmission to this country.

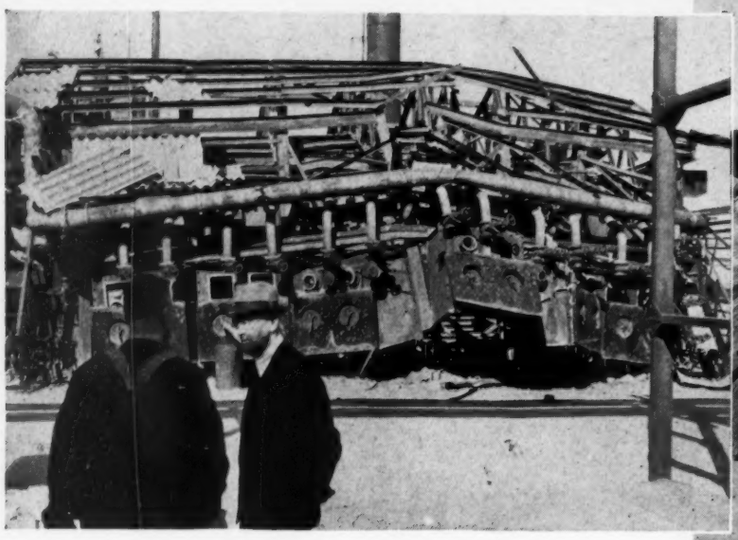
The third plant examined was at Ludwigshafen which the investigators reached within a matter of hours after it was captured. Here they found about ten barrels of buried documents, dealing particularly with aviation gasoline production and also yielding valuable information concerning rubber and chemical production.

At this point the team was divided into three sections, one going forward to the Ruhr, the second going to the I. G. Farbenindustries headquarters at Frankfort and the third to the Hidelburg area. The latter group had the good fortune to find M. Pier, father of modern hydrogenation, the most important German scientist in the commercial development of the hydrogenation process and aviation gasoline production. He gave a complete story not only of commercial developments but of the most recent research work.

"The one interesting idea that developed when we talked to Pier," Dr. Schroeder stated, "was the fact that the Germans had continued their research vigorously throughout all the war years. In the meantime, however, they had been prevented from trying this research in commercial production because it meant they had to shut down the plants to make the necessary changes which would mean a loss of adequate synthetic production which was needed so badly in the war. To the people of the United States this means we now have the advantage of their research with the prospect of using it to improve our own." This research material includes a considerable number of ideas and possibilities for marked improvement in the hydrogenation process.

The major proportion of German synthetic liquid products for fueling the war came from the Ruhr area, where there were a large number of Fischer-Tropsch and coal hydrogenation plants operating on bituminous coal and coal tar. All the Fischer-Tropsch plants operated under license from Ruhr-Chemie, a closely integrated organization which was a competitor of I. G. Farbenindustrie. One parent plant in the western half of the Ruhr made all of the catalyst which was shipped to the other plants in special heavy containers which excluded air. Comparison of the various plant designs and operations not only insured the accuracy of information obtained but revealed that the design was frozen about 1938.

The Germans made remarkable progress in the use of extremely high pressures as a routine operation. They had improved catalyst composi-



Ruhr-Chemie Cracking Plant.

Above: Ruins of Gas Purification Plant at Kamen-Dortmund.

Right: High Pressure Coal Hydrogenation Unit at Gelsenberg.

tion, particularly in production of high octane aviation gasoline. They also had eliminated one or two steps in their vapor phase hydrogenation process which simplified high octane gasoline production.

The Germans had been able to work out and develop under the Fischer-Tropsch process the synthesizing of isoparaffins to obtain high octane gasoline. Prior to this it had only been possible to obtain motor gasoline. This development is practically in a commercial stage now and the method of synthesizing isoparaffins will be of great importance to the American industry which had not yet reached this point.

Tracking down the Ruhr-Chemie research documents led the investigators on a strange trail. They learned the documents had been shipped some place further east in Germany but were not able to learn where until in Brussels they located Dr. F. Martin, president of Ruhr-Chemie, and Dr. Hagerman, second in command. These men revealed the documents had been evaculated to the small town of Reelkirchen. There, Ruhr-Chemie had taken over a picturesque old castle built in 1200 and surrounded by a moat. In the castle were the major part of the documents and sixteen people intent upon setting up a new process under the impression, apparently, that the area would be free from Allied invasion. The remainder of the documents were discovered when an American officer noticed a small boy playing with a group of blueprints and through this lead found that many of the farmhouses had been used as depositories. When the last of the documents were rounded up they filled six huge rooms solidly to the ceiling. "The upshot of that", Dr. Schroeder related, "is, I think, we now have all the research documents of Ruhr-Chemie. The story is the same for I.G.".

In the Leuna-Leipsig area, study of a Fischer-Tropsch pilot plant operated by I.G. Farbenindustrie revealed a number of unique features not found in Ruhr-Chemie plants. Of particular interest were gasification methods for brown coal, a subject upon which almost no detailed information is available in the United States. The investigators were able to make a thorough study of the Winkler and Lurgi methods of gasification and the effect of the use of oxygen in this equipment.

Total German synthetic gasoline and oil production reached a maximum of slightly under 350,000 metric tons per month in 1943. Bombing raids during the latter part of the year cut production 10 to 15 percent. Production increased when bombing decreased due to bad weather. Heavy spring raids of 1944 damaged the plants so severely that production dropped to a small percentage of maximum, with aviation gasoline suffering the most. At the end, daily aviation gasoline production was less than 100 bbls. which grounded the Luffewaffe. Repair crews, which at Luena for example, numbered 20,000 people, found it impossible to sustain operation.

This was of utmost importance as synthetic production accounted for 90 percent of all German aviation gasoline. Approximately 50 percent of motor gasoline and 50 percent of diesel oil were produced synthetically, but even the remaining percentages were dependent upon synthetic production which was used in blending.

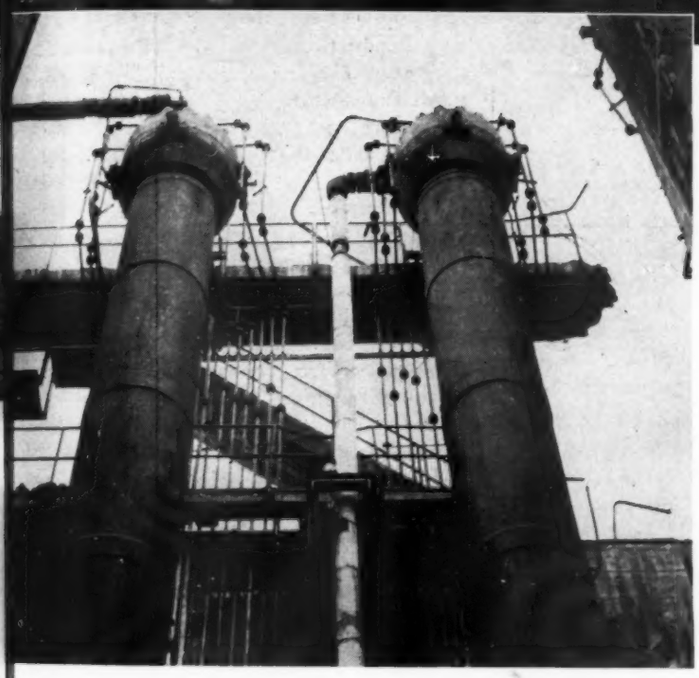
The Germans attempted to move as much synthetic industry as possible underground, but the change was undertaken too late. The plan was to excavate locations in hillsides for many relatively small units averaging 20,000 tons annual production each. None of these were ever put into operation and the most advanced were only about 80 percent completed at war's end.

The investigators uncovered some particularly interesting material concerning the by-products of the synthetic liquid fuel industry. The well-integrated German plants produced not only liquid fuels but also toluene, benzene, city gas, soaps, fats, margarine and edible material.

Most valuable information was obtained concerning processes for synthetic lubricating oil of high quality including processes quite different from those used in the United States. German synthetic aviation lubricating oil was found to be as good as that used by the Americans, if not better. From coal the Germans were able to duplicate every lubricating oil made in the United States from natural petroleum and give the products the same properties. The German process was to take ethane gas which when reacted with oxygen produced ethylene. Then the material went through a long purification process to eliminate acetylene, water, carbon dioxide, nitrogen and other gases, and resins. It was then put through a direct polymerization process to obtain very high aviation lubricating oil with a viscosity index of 105 to 115. This gave extremely good engine performance.

This process is of particular value to the American industry, for it is now possible to produce superior lubricating oils synthetically than it is from natural petroleum. The reason for this is that in the German process ethylene becomes the building block which can be controlled to obtain the types of molecules and properties which are desired, whereas with natural petroleum it is

Members of Synthetic Oil Study Team, Back Row—Left to right: L. P. Evans, Socony-Vacuum Co.; E. B. Peck, Standard Oil Development Co.; G. Von Elbe, Bureau of Mines; W. W. Odell, Bureau of Mines; and V. Haensel, Universal Oil Products. Second Row — Left to right: A. R. Powell, Koppers Co.; E. Cotton, Gulf Oil Co.; L. L. Hirst, Bureau of Mines; H. M. Weir, Consulting Engineer; H. V. Atwell, Texas Co.; and P. K. Kuhne, Gulf Oil Corp. Front Row—Left to right: D. S. Fraser, Chief, Technical Section, Foreign Refining Division, Petroleum Administration for War; E. L. Baldeschwieler, Standard Oil Development Co.; Dr. W. C. Schroeder, Chief, Office of Synthetic Liquid Fuels, Bureau of Mines, and leader of the group; and J. P. Jones, Phillips Petroleum Co. (Photo taken in Germany Courtesy Bureau of Mines)



Converter Towers at Gelsenberg.

necessary to start with a raw material which varies according to the composition of the oil. Various natural oils must be treated various ways to obtain the desired products. The German process enables the refiner to begin with a known material and to maintain complete control over his product. They had processes for making valuable higher alcohols for solvents and plastic manufacture.

It is extremely difficult to compare United States and German production costs. However, Dr. Schroeder estimated German aviation gasoline production cost would be from 16 to 25 cents per bbl. and that low grade gasoline would cost twice as much as that from natural petroleum.

In his opinion, as the result of the German data and American research, the United States will be able to produce synthetic fuels more economically than the Germans. For example, their bituminous coal costs were higher and America can produce steel more cheaply. Most important of all, American engineering designs are more efficient. The German method is to build a large number of small units whereas Bureau of Mines engineers already have devised methods, particularly for the Fischer-Tropsch process, for operating on a much larger, more compact scale, decreasing plant maintenance and labor costs.

"From what we already knew we could design a better Fischer-Tropsch process than the German's had," Dr. Schroeder commented, "however, they were far ahead of us in hydrogenation".

American technology has only concentrated on synthetic production since the beginning of the war. In spite of this relatively limited effort, industry and Bureau of Mines scientists have developed catalysts and engineering modifications for synthetic fuel processes which when studied in comparison with the best found in Germany, will determine the most feasible process for our own development. This application of our own discoveries and German research ideas places America in a position to outstrip the world in synthetic production and research.

In spite of the great strides forward which will now be made in synthetic fuel research in this country, Dr. Schroeder does not envision synthetic products on a competitive cost basis with natural petroleum products at present prices. However, if petroleum products costs increase due to an anticipated difficulty in future petroleum finding and synthetic costs decrease due to additional research, the two price levels may ultimately meet. If at that time, foreign oil is not heavily imported, it is possible that the synthetic fuel industry in this country will be established on a large scale.

The investigation also developed important military information concerning certain Japanese operations in the field.

From what the investigators were able to learn, it was apparent that synthetic plants in Russian occupied eastern Germany were not damaged as severely as those in western Germany. Negotiations are underway for an exchange of information between the Russian and Americans and for permission to inspect the eastern plants. However, as Dr. Schroeder pointed out, the extent of damage does not determine the amount of information obtainable. Main sources are documents and German personnel. In some respects, bomb damage is an asset in that vessels are blown open permitting study and measurement taking. All information obtained by the investigators will be available to American industry. Although it is still restricted material it is expected that it will be released to those interested by the end of this year.

The Bureau of Mines is already going ahead with its research on this new information and plans to build special pilot plants. In common with all industry it is having difficulty obtaining construction materials but in order to avoid delay the already established Pittsburgh plant is having its space increased so that the work may be pushed ahead.

Research and development of synthetic fuels in this country are now in a position which was not even dreamed of two years ago when the plans for this project were being laid.

SHIPMENT OF PETROLEUM PRODUCTS TO SPAIN WAS A MEASURE OF CAREFULLY DEVISED WAR STRATEGY

By James H. Mayes*

DURING the three years preceding the end of the European war, the United States government, in close cooperation with the British government, carried out an economic program in Spain which was directed toward the objective of maintaining Spain's neutrality, encouraging her resistance to Axis demands and keeping Spanish products out of Axis hands. To that end, a series of supply-purchase agreements were made, which involved supplying Spain with petroleum products and other commodities in short supply from sources under Allied control, in return for economic concessions from Spain.

Spain, situated midway between belligerents, was one of the main battlefields of the economic war waged by them. She has within her control tungsten and other commodities important to the war effort of both the United Nations and the Axis.

Spain was licking its Civil War wounds when the European conflict burst forth in 1939. Spain has no indigenous petroleum and is wholly dependent upon its importation. The principal sources of supply have always been Anglo-American controlled oil fields and refineries in the Caribbean area in the United States. The only other possible sources were, first, the Middle East, but hostilities in the Mediterranean precluded safe tanker voyages; secondly, Eastern Europe, likewise out of the question because of overland transportation difficulties and the reluctance of the Axis to give up any of this precious commodity.

Spain wanted both peace and oil. Franco was indebted to the Axis powers. They had helped to make him Spain's dictator. He was in the difficult position of being pro-Axis while, at the same time, he did not want to endanger his Anglo-American relations. Franco well realized that the very existence of his economic and political well-being depended upon petroleum, without which the explosive and oppressed Spaniards, prodded by Axis agents and agitators, might have started another civil war. The Germans, then on the Spanish-French frontier, would have had an ideal pretex for moving into Spain "to maintain order." With the Germans entrenched in both Spain and Spanish Morocco across the Strait of Gibralter, Britain's bastion rock would have been virtually encircled. The Spaniards had already emplaced Axis-inspired coastal batteries which commanded the Straits. With the western entrance of the Mediterranean closed to Allied shipping, the Axis would have had a free hand to overrun North Africa and the Middle East. Malta would have perished from lack of supplies.

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During the progress of the war in Europe there was much criticism of Allied authorities for permitting oil from the Western Hemisphere to enter Spain to meet that country's minimum needs for petroleum products. It was asserted that this constituted direct aid to a country whose government was openly sympathetic to the Axis powers and rumors were in circulation that some of the oil supplied to Spain actually was used in Nazi military operations. Now that the war is ended WORLD PETROLEUM *is glad to be able to publish the real story behind these oil shipments as told by the author of the accompanying article who had the difficult assignment of controlling petroleum exports to those European nations that remained neutral in the war.*

The Axis then could have moved on to Egypt and effectively closed the remaining Mediterranean entrance, the Suez Canal. Blitzing farther east and north, the vast Middle East oilfields, refineries and pipelines would have been prevented from contributing to United Nations' victories in Europe, Africa and the Far East. Russia would have been prevented from getting lend-lease supplies via the Persian Gulf. Turkey, the Balkans — it is needless to ask what would have been their fate.

Franco was fully aware of his strategic position. On the other hand he knew that unless he got American petroleum, conditions within his domain would become chaotic. The Americans and the British realized that unless a strong restraining hand could be imposed, Spain might quickly become an Axis-occupied and Axis-dominated state.

The American and British authorities jointly devised programs for supplying Spain and her colonies with the minimum economic requirements of aviation gasoline, automotive gasoline, kerosene, industrial fuels, lubricants, and other petroleum products. Each program was, in effect, an agreement to provide the supplies, if available, on a six-month basis. Maximum quantities of stocks to be maintained in Spain were established. American petroleum observers, attached to the U. S. Embassy in Madrid, were stationed throughout the country and controlled the discharges, storage, distribution and end-use of these products. It may be added that, except in isolated instances of negligible quantities being contrabanded or black-marketed, no Allied oil found its way into Axis consumption. The Spanish authorities cooperated fully in the operation of the control measures, knowing well that proved instances of deliberate diversion to enemy channels would result in cessation of supplies.

The quantity of petroleum products made available to Spain yearly under this wartime petroleum program approximated 750,000 metric tons, or two-thirds of its normal requirements, broken down as follows:

Product	Tons
Aviation Gasoline	3,800
Motor Gasoline	190,000
Kerosene	8,000
Gas & Diesel Oil	106,000
Fuel Oil	210,900
Lubricants	39,000
Asphalt	30,000
Petroleum, White Oils, Wax, etc.	2,300
Crude Oil	160,000

The bulk products, comprising about 97 percent of the program, were transported to Spain from Caribbean oil fields and refineries by a fleet of nineteen Spanish tankers. The finished bulk products were refined in the Netherlands West Indies. The crude was Venezuelan, about half of which was produced on a royalty basis from Spanish concessions in the Lagunillas area of Lake Maracaibo, transported by lake tankers to a deep-water terminal in the Caribbean and there lifted by Spanish tankers.

The remaining three percent of the tonnage comprised packaged products, chiefly lubricants and asphalt. These had to be furnished from the United States, as they were unavailable elsewhere. Vessels of Spanish registry transported these packages to Spain. Most of these packaged products were loaded at Philadelphia, as wartime restrictions forbade vessels of neutral nations from entry into ports of the United States other than Philadelphia and New Orleans.

A strict control was exercised over all shipments. Each tanker loading was supervised by American authorities. A loading and inspection certificate of each cargo was sent to the American petroleum observer at the port of destination for checking the quantity of oil received in Spain against the quantity loaded in the Caribbean. All of the discharge valves of the tankers' compartments were sealed to make certain that there would be no tampering with the cargoes at sea, and the serial numbers of the seals were

recorded in the loading and inspection certificates. Every precaution was taken to make certain that enemy submarines in the Atlantic received none of the fuel. In addition to these control measures, each lifting was navicerted by the British and each tanker underwent an official security control inspection of vessel and crew at Trinidad, both eastbound and westbound.

A similar cargo control was exercised over packaged products loaded on dry cargo vessels at United States ports. The program quantity was controlled by the issuance of export licenses by the Foreign Economic Administration. The exporter was compelled to surrender an approved export license to the Collector of Customs at Philadelphia or New Orleans upon making each consignment. The Foreign Economic Administration compiled data of each sailing from these exports licenses and steamship manifests and cabled the American authorities accordingly while the vessel was homeward bound. The U. S. petroleum attaches in Spain checked each cargo discharged and compared the outrun with this cabled loading data and the steamship's manifest.

A strict control was also exercised over bunker fuels and lubricants. Tales that Spanish vessels refueled enemy submarines in the Atlantic never had any verification. The precautions taken made any such action virtually impossible.

Marketing in Spain is done by the semi-official Compania Arrendataria del Monopolio de Petroleos, S. A., generally referred to as CAMPSA. The Spanish government established a monopoly about fifteen years ago. CAMPSA manages this monopoly and is the sole importer of gasoline, middle distillates, fuel oil and wax. About two-thirds of these products are supplied by American exporters, the remaining one-third by British interests.

CAMPSA's sixteen tankers transport bulk products from the Caribbean to bulk terminals at various Spanish ports. CAMPSA moves the products inland to its various bulk installations, of which there are about seventy, and distributes the products to the trade.

Other finished products, which are packaged, are supplied on approximately an equal percentage basis by American and British interests.

CAMPSA's monopoly concession expires in 1947. It now appears that its concession may be renewed but, of course, no prediction can be made at this early date, particularly in light of present political conditions in Spain.

A refinery with a maximum throughput of about 12,000 barrels daily is operated in the Spanish possession of Tenerife, Canary Islands, by Compania Espanola de Petroleos, S. A., commonly referred to as CEPSA. The refinery has a cracking unit and produces gasoline, kerosene, gas oil, fuel oil and asphalt.

The Anglo-American petroleum program restricted the supply of crude for this refinery to about one-third of its maximum capacity. During the wartime period the finished products were sold by CEPSA locally or the Spanish colonies in Africa or in the Atlantic. In peacetime, when the refinery operated unrestrictedly, CEPSA sold not only locally and to the colonies but also, on a strictly competitive basis, to CAMPSA, holder of the marketing monopoly for continental Spain. CEPSA also sold finished products to France and Portugal and had a large bunkering trade.

CEPSA is an independent, privately owned organization. Some of its shareholders, however, are politically prominent. The company was organized in 1929. It operates three tankers and obtains about 4,000 barrels of royalty oil daily from crude concessions in Venezuela. The remainder of CEPSA's requirements for its refinery are purchased on a commercial basis.

A reciprocal factor of the petroleum program was the tangibles Spain had available for export. At the outset of hostilities, the United States needed tungsten. The British were dependent upon Spain for iron ore, mercury, pyrites, potash, vegetables and fruits. For Germany, Spain was vitally important as a source of tungsten, zinc, wool and woolen goods, sheep and other skins, turpentine, cork, and olive oil.

Germany needed wolfram much more desperately than did the Allies. To prevent the Germans from getting it, Allied representatives paid high prices for all they could lay their hands on. The Spaniards realized the necessity and motive of this preclusive purchasing; not satisfied with exorbitant prices for the wolfram, they imposed export taxes on it. To counterbalance these new taxes, we doubled the prices of the refined petroleum products lifted by their tankers. Franco finally rescinded these export taxes and we in turn discontinued the retaliatory 100 percent overpricing of their gasoline and fuels.

Early in 1944 the Allies wanted certain concessions from Spain, including the release of several Italian ships interned in Spanish ports; expulsion of Axis agents, particularly those in Spanish Morocco spying on our North African operations; and an embargo placed on shipments to Germany of what little wolfram the Axis could buy in Spain. Franco was reluctant to accede to these demands, so we placed an embargo on all loadings of petroleum for Spain.

Having previously established maximum stock limits of petroleum to be stored in Spain, it was a question of time until these stocks became so low that Spanish economic and political stability was endangered. Germany made a feeble offer to ship an insignificant quantity overland from Hungary, which never materialized. After three months of the Anglo-American blockade, during which time the local stocks had been considerably reduced, Spain submitted. This clearly established petroleum as the number one commodity for attaining economic objectives desired of Spain and other neutral nations.

From time to time, press and radio reports implied that pro-Axis Franco had such a superbundance of petroleum products that he was able to supply it to Germany; that Americans, in contrast, had to tolerate "A" gasoline rations and go without ample heating oil for their homes.

Actually, no gasoline, kerosene, gas oil for fuel oil was shipped to Spain from the United States. These products were manufactured at Caribbean refineries from South American crude oil. In many instances, aside from the reciprocity features of the program, the Spaniards actually contributed to the Allied war effort by lifting some of these bulk products. We did not have tankers available to bring this petroleum to the United States; the products occupied shore tanks needed for the storage of petroleum essentially required for use in prosecution of the war. Without ample storage facilities, the refineries would have had to curtail their production of aviation gasoline and other military requirements. In fact, for a brief period, one of the Carribean military requirements because of excessive stocks of Bunker "C" fuel oil.

The packaged products, shipped from the United States to Spain in relatively small quantities, were never in critically short supply. On infrequent occasions when these products were required by the military or the Allied nations, export license applications were denied approval by the Foreign Economic Administration.

It remains to be seen whether or not Spain will continue to import its petroleum requirements from the Western Hemisphere. With ample tankers now operating and under construction, Spain is in a good bargaining position. The distance from Spain to the eastern Mediterranean is about half of that to the Caribbean or the United States Gulf; from Spain to the Persian Gulf, via Suez, is about the same distance as between Spain and the Carribean or United States Gulf. The shorter tanker haul, plus the larger surplus of petroleum products in the Middle East, unquestionably, will have a bearing on the future source of Spain's bulk requirements.

Spain is now entering its first normal economic period in about ten years. Its civil war began in mid-1936 and no sooner ended in 1939 than World War II started. Spain's future consumption of petroleum products should far exceed that of recent years, making that country an important outlet for refined and crude petroleum.

MORE GASOLINE FROM VIRGIN GAS OIL

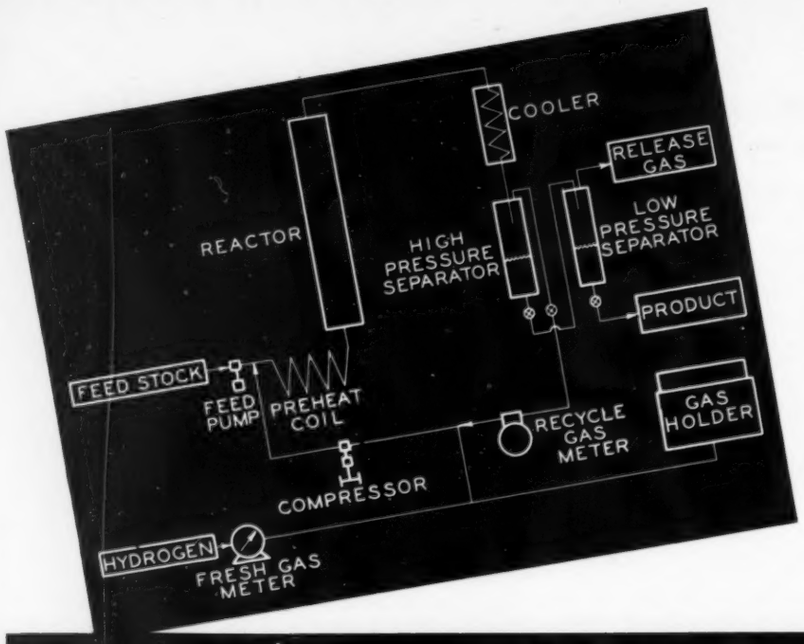


Fig. 1 — Laboratory High Pressure Hydrogenation Unit.

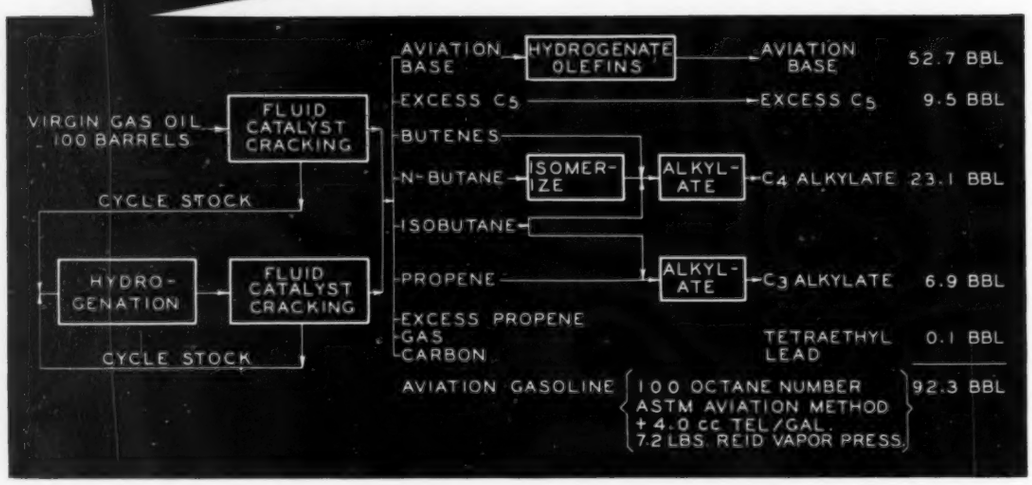


Fig. 2 — Aviation Gasoline from Southwest Louisiana Wide Cut Gas Oil By Catalytic Cracking Plus Hydrogenation.

THE catalytic cracking process is an efficient and generally satisfactory means of producing high quality aviation and motor oils from virgin gas oils, but as applied to these stocks it now has certain limitations which it is desirable to remove. One of the characteristics of the catalytic cracking process is the fact that the by-product cycle stocks are considerably more resistant to further cracking than the original virgin stock. In fact, it is axiomatic in catalytic cracking that the cycle stock becomes progressively more refractory with increasing conversion.

This being the case, it becomes desirable to consider methods for upgrading the cycle stocks to improve their quality as cracking material, and thus to obtain a maximum yield of gasoline from a given amount of a given crude oil.

This matter has been the subject of research on a pilot plant scale at the Esso Laboratories of the Standard Oil Company of N. J. (Louisiana Division) in Baton Rouge,* who show how this object can be accomplished by hydrogenation, with yields in excess of 100 volume percent.

During the war, the high-pressure hydrogenation process made a most valuable contribution to the "100 octane" aviation gasoline program in the following types of operation (a) production of commercial iso-octane from butylene polymers; (b) saturation of catalytically cracked aviation base stock to improve stability and leaded octane number, and (c) direct manufacture of high quality base from virgin and cracked kerosene fractions of predominantly cyclic character. Operations (a) and (b) involve merely the addition of hydrogen to convert olefins to paraffins, and is called simple or saturation hydrogenation. But in the case of catalytically cracked aviation base stock, it is important to restrict the addition of hydrogen to the olefins, and to avoid saturation of the aromatic hydrocarbons to naphthenes. The direct manufacture of aviation base from kerosene fractions, process (c), is an example of destructive hydrogenation, since it involves a combination of simple hydrogenation and other catalytic reactions such as pyrolysis and isomerization.

The special object of this work at the Esso Laboratories was still another adaptation of the hydrogenation process. This is also a case of simple hydrogenation, not restricted to olefins but rather directed to the saturation of aromatics, especially the refractory condensed-ring molecules which abound in catalytically cracked cycle stocks. The same conditions are employed as for destructive hydrogen, and all that is necessary to accomplish the desired selective simple hydrogenation is a change of catalyst. As in destructive hydrogenation, in simple hydrogenation high pressures (3000 psig.) are preferred but with a sufficiently active catalyst it is possible to get appreciable hydrogenation at moderate pressures (750 psig.) at 550° to 750°F.

Among the objects to be attained in such work is to improve virgin gas oils as Diesel fuels by saturation of aromatics to improve cetane number, eliminate sulfur and to rework cracked gas oils where the margin of improvement by hydrogenation is much greater, whereby excellent Diesel fuels can be prepared from very poor material. However, the broadest field for the saturation hydrogenation of gas oil may be in the upgrading of catalytically cracked cycle stocks for further catalytic cracking, thereby producing more gasoline from a given amount of crude oil.

The type of pilot plant used for high pressure hydrogenation in this work is shown in diagramatic form in Fig. 1. The feed stock to be hydrogenated is introduced through a high-pressure feed pump. After mixing under pressure with an excess of hydrogen it is heated in a coil to the reaction temperature and passed through the reactor containing the synthetic silica-alumina catalyst. The reaction products are cooled, the liquid and excess gas are separated, and the excess gas is recycled by means of a compressor. Fresh make-up hydrogen is continuously added; the product from the high pressure separator, after reduction to atmospheric pressure, is separated from dissolved gases in a low pressure separator.

A sample of the results obtained in this work is given in Table I. A virgin heavy gas oil from a mixture of East Texas, Van Zandt and Talco crudes was catalytically cracked for producing motor gasoline. The cycle stock from this operation was subjected to simple hydrogenation to obtain both a partial and a rather complete saturation of the cycle stock.

Looking at this table it will be seen that the yields of hydrogenated product were over 100 volume percent and that there was comparatively little formation of light ends even at the more complete saturation level. In the more highly

*Hydrogenation and desulfurization of cycle stocks from catalytic cracking, C. L. Brown, Alexis Voorhies, Jr., and W. M. Smith, presented before the Baton Rouge Section of the American Chemical Society, Oct. 1945.

TABLE I

Hydrogenation of Cycle Stock From Fixed Bed Catalytic Cracking of East Texas-Van Zandt-Talco Mixed Heavy Gas Oil

	Unhydrogenated Cycle Stock	Partial	Hydrogenated Cycle Stock Almost Complete
Degree of Hydrogenation	—		
Pressure, psig.	—	—	3000
Feed Rate, Vol./Vol./Hr.	—	—	2
Yield, Vol. % on Feed	—	104	110
Gravity, API	27.2	31.0	35.0
5% @ °F.	500	470	430
10% @ °F.	520	500	470
30% @ °F.	590	570	550
50% @ °F.	640	620	600
70% @ °F.	690	670	650
% @ 700°F.	77	83	85
Color (Salbolt)	5 Robinson	+4	+18
Aniline Point, °F.	156	165	181
Diesel Index	42	51	63
Bromine Number, cgs./gm.	8	2	2
Sulfur, Wt. %	0.78	0.21	0.06
Hydrogen, Wt. %	12.2	13.0	13.7
Refractive Index @ 30°C., n_D^d	1.5051	1.4845	1.4692
("F-"C)10'	170	125	112
Aromatic Rings, Wt. %	22	14	6

saturated product the sulfur of the feed stock was reduced from 0.78% to as low as 0.06%. The extent of the saturation of the products in the two runs is shown by their low aromatic contents, high Diesel indices, high hydrogen percentages and low specific dispersions as compared with the material at the start. The relatively high space velocity (namely, 2 volumes of liquid feed per 1 volume of catalyst per hour) is indicative of the high catalyst activity.

Included among other feed stocks used in this work were virgin gas oils from southwest Louisiana and from Refugio crudes, which were catalytically cracked at 975°F. and 60% conversion to produce aviation gasoline and C_4 hydrocarbons. The hydrogenation operations were carried out at 3000 lbs. pressure with sulfactive catalysts. The hydrogenation runs were made to give complete saturation of the aromatics. Again it was noted that the liquid yields were in excess of 100% with comparatively little formation of light ends, and the high degree of refinement of the hydroproducts was indicated by their excellent colors. In these operations the cycle stock being hydrogenated represented the total cracked product boiling above the aviation gasoline, because it was of interest to find the maximum yield of aviation gasoline and C_4 hydrocarbons that could be obtained by combining catalytic cracking of the virgin feed stock with catalytic cracking of the hydrogenated cycle stock.

Calculations of yield and quality of aviation gasoline obtainable in this integrated recycle catalytic cracking process are shown diagramatically in Fig. 2 for the case of southwest Louisiana feed stock.

Conditions are less favorable for complete saturation at lower pressures, but an appreciable degree of hydrogenation is obtainable under conditions consistent with adequate catalyst life. The process is especially effective where the principal object is desulfurization. For instance, a high-sulfur virgin gas oil and a high-sulfur catalytically-cracked cycle stock (both from West Texas crudes) were catalytically hydrogenated at 750 psig. with results shown in Table II (V).

The yields are high and the indices of aromaticity (specific dispersion, aniline point, hydrogen content, Diesel index, weight % aromatic rings) all indicate appreciable hydrogenation of aromatic rings. But the most significant improvement is shown in the sulfur content of the hydroproduct. This is especially notable in the case of the cracked cycle stock, because it is well known that the sulfur-containing molecules in such materials are very refractory.

Conclusion

It has been shown in this paper that simple hydrogenation of catalytically cracked cycle stocks at 3000 pounds pressure gives an extraordinary improvement in the quality of these materials to the point where they are much more desirable cracking stocks than the original virgin feeds. The potentialities of this type of operation are apparent as a conservation measure to obtain the highest possible yield of gasoline from virgin charging stocks. Moreover, this increase in yield is secured without any sacrifice in the quality of the gasoline produced. The economics of such an operation will obviously depend to a large extent on the differential in value between the virgin charging stock and the by-product cycle stock.

Low pressure hydrogenation, which is cheaper than high pressure, can do an intermediate job on the hydrogenation of cycle stocks, and can do a rather complete job on their desulfurization. In certain cases it may also be desirable to apply low pressure hydrogenation to desulfurization and partial saturation of virgin gas oil. The choice between low pressure and high pressure hydrogenation will depend on local situations and the general price structure for petroleum and its products, which in turn hinges on the cost and scarcity of crude oil and the relation of coal and fuel oil prices.

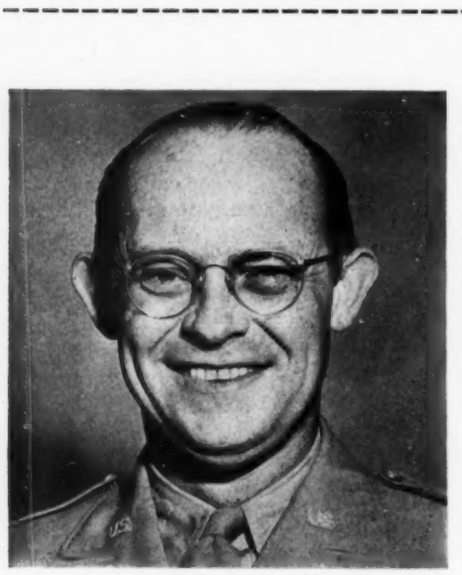
As a means of conserving petroleum supplies from a standpoint of national policy, the hydrogenation of catalytically cracked cycle stocks should command thoughtful attention.

TABLE II (V)

Desulfurization of High Sulfur Gas Oils By Low Pressure Hydrogenation

	West Texas Wide Cut Gas Oil		West Texas Light Gas Oil	
	Cat. Cracked Cycle Stock	Hydro Cycle Stock	Virgin Gas Oil	Hydro Gas Oil
Yield, Vol. % on Feed	—	100	—	101
Gravity, °API	23.3	27.3	31.9	34.7
Initial Boiling Point, °F.	470	430	390	360
5% @ °F	510	480	480	460
10% @ °F	520	500	500	490
30% @ °F	550	540	540	530
50% @ °F	590	580	580	570
70% @ °F	640	630	610	600
90% @ °F	700	700	660	650
Final Boiling Point, °F.	90% @ 700°F.	90% @ 700°F.	700	690
Color (Robinson)	½	8	9	19
Aniline Point, °F	128	133	153	161
Diesel Index	30	36	49	56
Bromine Number, ogs./gm	18	9	11	3
Sulfur, Wt. %	1.42	0.15	0.95	0.07
Hydrogen, Wt. %	11.2	12.0	13.0	13.5
Refractive Index @ 20°C., n_D^d	1.5174	1.5012	1.4817	1.4723
Specific Dispersion @ 20°C., ("F-"C)104	180	145	127	118
Aromatic Ring, Wt. %	27	24	15	12

Oil Company Staff Changes



Lt. Col. William R. Boyd 3rd

M. G. Gamble

LT. COL. WILLIAM R. BOYD, 3RD, has joined Petroleum Advisers, Inc., management and technical coordinating unit for petroleum operating subsidiaries of Cities Service, to assist in postwar marketing plans. His headquarters will be in New York. During the war, Col. Boyd served in North Africa and England, finally becoming chief of the continental branch of the petroleum section in the supply division of the Air Technical Service Command. He was awarded the Bronze Star Medal.

Col. Boyd is the son of William R. Boyd, Jr., president of the American Petroleum Institute and chairman of the Petroleum Industry War Council. Before the war he served Sinclair Refining Company in several areas, his last post being that of assistant southwest district manager. His duties included those of manager of the real estate department, sales promotion and merchandising.

M. G. GAMBLE has been appointed general manager of the marine department of Standard Oil Company (New Jersey). He succeeds B. B. Howard, recently elected to the board of directors of the company. As assistant general manager during the war, Mr. Gamble was active in coordinating the operations of the Esso tanker fleet while under requisition to the War Shipping Administration to transport oil products to the war fronts.

John J. Winterbottom, manager of the marine traffic division, presently on leave with the War Shipping Administration, has been named an assistant general manager. E. H. LeTourneau continues as an assistant general manager.

Following his graduation in 1915, Mr. Gamble served in the Navy until the close of World War I. He resigned from naval service in 1919 to enter the construction and repair division of Jersey Standards' marine department. After two years in machinery construction work, he transferred to the operating division. In 1937 he was made assistant in the traffic division, handling marine affairs in Venezuela and Aruba and lake-tanker shipments in Caribbean ports. The following year he became manager of the newly created Caribbean division, and in 1939 went to Aruba as marine manager, directing activities in Venezuela and the Caribbean. He was appointed assistant general manager in New York in 1942.

John J. Winterbottom entered the foreign shipping department of Jersey Standard in 1916. In 1930 he went to London as advisor to marine managements of European subsidiaries. He was appointed manager of the traffic division in 1940. Mr. Winterbottom will take up his duties as assistant general manager on his release from WSA.

E. H. LeTourneau, who served as lieutenant commander, USNR, in World War I, was manager of the repair division of the marine department from 1921. He was named an assistant general manager in 1944.

F. H. HOLMES, former superintendent of The Texas Company's refinery at Lockport, Illinois, has been transferred to Texaco's Port Arthur Works, Port Arthur, Texas, as general superintendent of that plant, according to an announcement by M. Halpern, vice-president in charge of refining.

At the same time, D. P. Bailey, Port Arthur's general superintendent, was made assistant to F. L. Wallace, works manager. L. V. Phillips, superintendent at the Texaco refinery in Lawrenceville, Illinois, for the past two years, was transferred to Lockport to take the post vacated by Mr. Holmes. Mr. Phillips' position at Lawrenceville has been filled by the appointment of F. M. Dawson, who has recently been a refinery superintendent in Argentina.

GEORGE GALLOWAY of Tulsa has been appointed district geologist for Stanolind Oil Company to succeed Roy D. McAninch who has resigned to open an office as a consultant in Oklahoma City.

HOWARD C. PYLE, former production engineer for Union Oil Company, who recently completed two and a half years of Army service, has been elected a vice-president of the Bank of America, Los Angeles. In his new position he will have charge of the petroleum department which the bank has established.

ARTHUR F. CORWIN, vice-president, director and a member of the executive committee of the Socony-Vacuum Oil Company, Inc., retired on October 1 after 46 years in the oil industry. He has been in charge of crude oil production for the company.

Mr. Corwin was graduated from the Sheffield Scientific School at Yale University in 1899 and entered the business in the fields of West Virginia and Pennsylvania. He became president of the Carter Oil Company in 1915 and remained with that company until 1926. At that time he was made a director of the Standard Oil Company of New York and then a director of Socony-Vacuum, its successor, in 1932. He has been a member of the executive committee since 1933 and a vice-president since 1934.

Arthur F. Corwin

JOHN M. PEIRCE, well-known economist and tax consultant, has joined the staff of the Western Oil and Gas Association. He is a native Californian, born in Azusa, and educated in California public schools. He is a graduate of the University of California and the Graduate School of Business Administration of Harvard Univesrity, and is the author of numerous magazine articles on government, taxation and business economics, and the "History of California Constitution."

HENRY W. HEWETSON has been elected president of Imperial Oil Ltd. to succeed the late R. U. LeSueur. Frank W. Pierce becomes chairman of the board. Mr. Hewetson has been connected with the company for twenty-five years starting as a student engineer and working his way up through the research and manufacturing departments to become a vice president in 1940. Mr. Pierce is a member of the board of Standard Oil Co. (N. J.) of which Imperial is a subsidiary.

JOHN F. DODGE, since 1929 head of the division of petroleum engineering at the University of Southern California and well known consulting petroleum engineer, has joined Pantepec Oil Company of Venezuela, C. A., as vice-president and manager with headquarters in Caracas. He will retain his association with the University. Prior to that connection he was for many years petroleum engineer with the Kern Trading and Oil Company, Pacific Oil Company and Standard Oil Company of California.

D. L. BARRETT has been appointed manager of the industrial fuel oil department of the Standard Oil Company of New Jersey, it is announced by A. Clarke Bedford, executive vice-president.

Mr. Barrett started his career with the company in 1922.

D. L. Barrett

John B. Macauley

JOHN B. MACAULEY has been appointed director of engineering research for Ethyl Corporation to succeed Earl Bartholomew, who becomes general manager of research laboratories. Macauley, who is widely known for his contributions to the coordination of fuel and engine research, has been chief of applied research for Pratt and Whitney Aircraft for the past two years and for 20 years was chief of the engine laboratory of the Chrysler Corporation.

Mr. Bartholomew has been associated with Ethyl Corporation since 1926, serving since 1927 as director of engineering research. He taught mechanical engineering at Oklahoma University for one year and at Harvard University for three years.

SINCLAIR REFINING COMPANY announces the appointment of R. J. Bender as assistant to C. M. Larson, chief consulting engineer. Mr. Bender joined Sinclair in 1932, and until the war served as fuel oil sales engineer in the Chicago district. Under the nickname of "Chief Bender" he was, for ten years, the publisher of "The Sinclair Firebox."

During his two and one-half years in the Navy Lt. Bender had a unique opportunity to study in action the application of Allied as well as enemy petroleum products of all types. As Technical Liaison Officer with Petroleum Section AFHQ, in the Mediterranean area for a year, he handled a great variety of problems related to the use of oil products including analysis in the Army portable laboratories of captured enemy petroleum. He worked with army engineers on building and rehabilitation of storage depots and construction of pipelines in Italy, Corsica and on the landing beaches of Southern France.

Lt. Bender was one of the group of technicians who entered Germany with our advancing army to obtain first-hand information on the scientific achievements of the Germans, especially in the field of synthetics; diesel fuel, aviation gasoline.

Philip S. Magruder

PHILLIP S. MAGRUDER has been elected to the board of directors and appointed manager of the manufacturing department of General Petroleum Corporation. He succeeds the late Raymond C. Wheeler who died suddenly last August 19.

Magruder joined General Petroleum in 1925 after more than eight years with Gulf Oil Corporation and Texas Pacific Coal and Oil Company. He was employed by General first as gas tester, but soon became gas engineer, then general superintendent, and in 1942 manager of the gas department. In May 1945 he was made assistant manager of manufacturing.

One of the organizers of the California Natural Gas Association, Magruder served as chairman of the technical committee in 1933-35, vice-president in 1936-39, and president in 1939-40. Currently he is director and member of the executive committee of the CNGA.

C. T. FURRER and Chester R. McMillan, two top-flight marketing men in the Standard of California organization have exchanged jobs. Furrer becomes manager of the Long Beach district and McMillin becomes president of Standard Stations, Inc.

"The transfer of these two executives," McClanahan said "is in line with our company's program for diversifying executive talents and broadening the experience of the two men charged with responsibility for our marketing operations."

KENNETH E. YANDELL, a pre-war employee with a record of two hitches in the Navy, one as electrician's mate, the second as a commander in World War II, has returned to Standard Oil Co. of New Jersey as Veteran's Administrator. This is an entirely new job on the Employee Relations Department staff. He will be available to management as an aide and consultant on all problems bearing on the re-employment, rehabilitation and placement of veterans.

CATALYTIC CRACKING ADAPTED TO SMALLER REFINERIES

War-time Experience has shown that Post-war Refiners Must Install Catalytic Cracking if They Hope to Operate Economically and Sell Their Products on a Competitive Basis — Efficient Small-scale Units Now Become Available for Medium and Small Refineries.

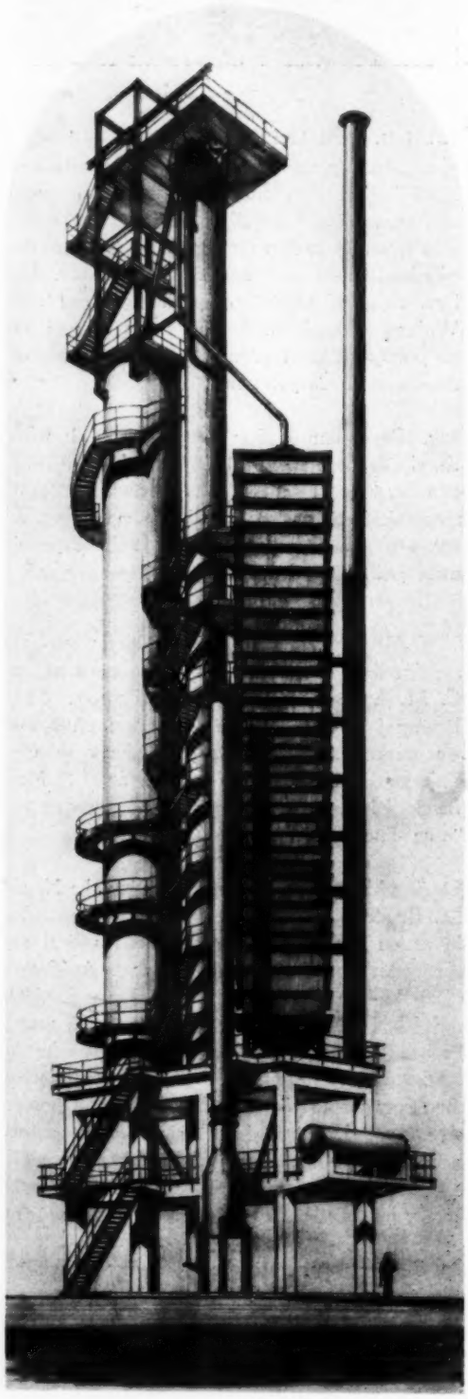
EASILY the most important wartime development of the petroleum industry was the introduction of catalytic methods of cracking. The various catalytic systems introduced greatly increased the production of high test fuel and at the same time broadened the base for supplying it by making it possible to obtain high octane gasoline from low grade stocks not previously usable for that purpose.

So many technical and economic advantages are possessed by catalytic cracking as demonstrated by the experience of the past few years that it came to be accepted as a truism that refineries not equipped to employ it would have great difficulty in maintaining a competitive position following the war. Although a great number of large catalytic plants were built between 1940 and 1945 to meet the heavy military demands for aviation and other gasoline, it remains true that only 52 refineries representing 58 percent of the total refining capacity of the United States are equipped with catalytic processes while outside this country less than a dozen such installations have been made. Thus the industry is divided into two groups; the one group includes those with adequate catalytic capacity that will enable them to put out a greater yield and an improved quality of motor fuel; the other is still limited to thermal cracking, and this group will have great difficulty in meeting competition on the basis of quality and cost.

Most of the catalytic cracking installations built during the war were huge affairs, and at first it was not considered economical to design such plants with capacities much less than 20,000 barrels of crude per day. Under these conditions the small refiners with limited capital would be denied the advantages of catalytic cracking. In view of this situation the designers have worked to develop small catalytic units that would enable the smaller refiners to meet the challenge of their larger competitors by producing motor fuel of at least equal quality and at a cost that will allow them a satisfactory margin of profit. The goal of the designers was to produce a unit that could catalytically process two to ten thousand barrels per day of charging stock with an investment per barrel of capacity and an operating cost comparable to those of the larger plants.

The Houdry Process Corporation, a pioneer of catalytic cracking, has brought out a small unit which provides an answer to this problem. This small unit represents a simplification of the design (while still retaining the principle) of the large Thermofor Catalytic Cracking (TCC) units built for the war program. This simplification in design has been made possible by experience gained in the design and operation of many previous installations which has resulted in savings both in maintenance and operating costs. It is said that a small Houdry TCC unit can be operated by a crew of four men.

Figure 2—Catalyst Kiln



A typical flow diagram of the preparation of the charge and the layout of the TCC unit is shown in Fig. 1. The reduced crude from the crude fractionator is passed through a heating furnace, the tar is separated from the oil vapor, which is passed upward through the TCC reactor and on to the product fractionators where propylene, butanes, gasoline, catalytic gas oil and recycle stock are separated. Bottoms from the tar seperator are heated in a furnace to break viscosity and enter the viscosity-breaker flash tower, where an overhead of butanes, gasoline and gas oil is taken off and sent to the catalytic reactor, while the bottoms from the flash tower are recovered as fuel oil. Meanwhile, spent catalyst from the reactor is continually passing through the catalyst regenerating kiln; a picture of this kiln is shown in Fig. 2.

Heretofore, most methods of improving the octane quality of gasoline have involved a sacrifice in gasoline output in order to improve quality but now catalytic cracking provides a means for obtaining a high quality motor fuel without sacrifice in ultimate output. The fact is that catalytic cracking increases the overall yield of gasoline and reduces the yield of residual fuel oil.

The value of catalytic cracking to a refiner will, of course, depend on a number of considerations. Perhaps the most vital are these two:

(1) The relation of gasoline price to the price of residual fuel oil.
(2) The octane number required for the refinery's regular grade and premium fuels.

Only a thorough analysis of his individual situation will give the refiner his final answer.

The refiner who uses catalytic processes to treat 10,000 barrels per day of crude oil may consider the following four basic cases:

(1) Two-coil thermal cracking with varying degree of reforming and catalytic polymerization.
(2) Viscosity breaking, once-through catalytic cracking, thermal cracking of the TCC cycle

stock, and catalytic polymerization with varying degrees of reforming.

(3) Viscosity breaking, recycle catalytic cracking, thermal cracking of the cycle stock, and catalytic polymerization; reforming is not employed in this case.

(4) Viscosity breaking, recycle catalytic cracking, and catalytic polymerization. Thermal cracking is not required in this case, as the light catalytic cycle stock may be used as No. 2 fuel oil and the catalytic cycle stock in No. 6 fuel blends.

These four cases include the assumption that there will be produced 1500 barrels of kerosene and 1100 barrels of Diesel fuel per calendar day; these would be marketed as virgin stocks from the crude. In addition, a series of cases (5 to 8) have been developed by Houdry engineers on the basis of cracking the virgin Diesel fuel and two cases (9 and 10) on the basis of producing asphalt for sale.

In every case except where asphalt is produced it is assumed that the viscosity of the reduced crude would be broken in order to minimize residual fuel, so that the total vaporizable fluid from this operation flows directly to the catalytic cracking unit. Various other processing methods, such as propane deasphalting or vacuum flashing, can be employed to charge a heavier stock to the catalytic plant, but the processes are not considered in this brief presentation of the subject except where manufacture of asphalt is involved.

Since refiners who are now confined to thermal cracking will be interested in a comparison of the thermal process with catalytic cracking Table I has been prepared to show how the two methods compare in a refinery that runs 1100 barrels of crude oil to still per calendar day; this table refers to operations wherein Diesel oil and asphalt are produced for sale.

TABLE I
Summary of Yields and Process Equipment
(Diesel and Asphalt to Sales)

Type Operation	Thermal Cracking and Reforming	Catalytic Cracking Thermal Cracking TCC Cycle
Case No:	9	10
Products:	B/Calendar Day	B/Calendar Day
10# RVP Gasoline	4,710	5,708
Kerosene	1,500	1,500
Diesel Fuel	1,100	1,100
Residual Fuel	1,429	755
Asphalt	600	600
Excess Butane	36	—
Dry Gas	670	455
Crude Run	10,000	10,000
Process Equipment:		
Crude Distillation	11,100	11,100
Vacuum Reduction	3,330	1,665
Thermal Cracking Gas Oil	4,330	2,000
Thermal Cracking Reduced Crude	—	—
Thermal Reforming	1,775	—
T. C. C.	—	4,330
Catalytic Polymerization	210	271
Octone Nos.		
CFRM / O cc TEL	69.9	68.6
TEL to 76 CFRM	0.80	0.90
TEL to 78 CFRM	1.35	1.35
TEL to 80 CFRM	2.00	2.00
TEL to 82 CFRM	3.05	2.90

Besides this technological comparison it will be interesting to make a financial comparison, as given in Table II.

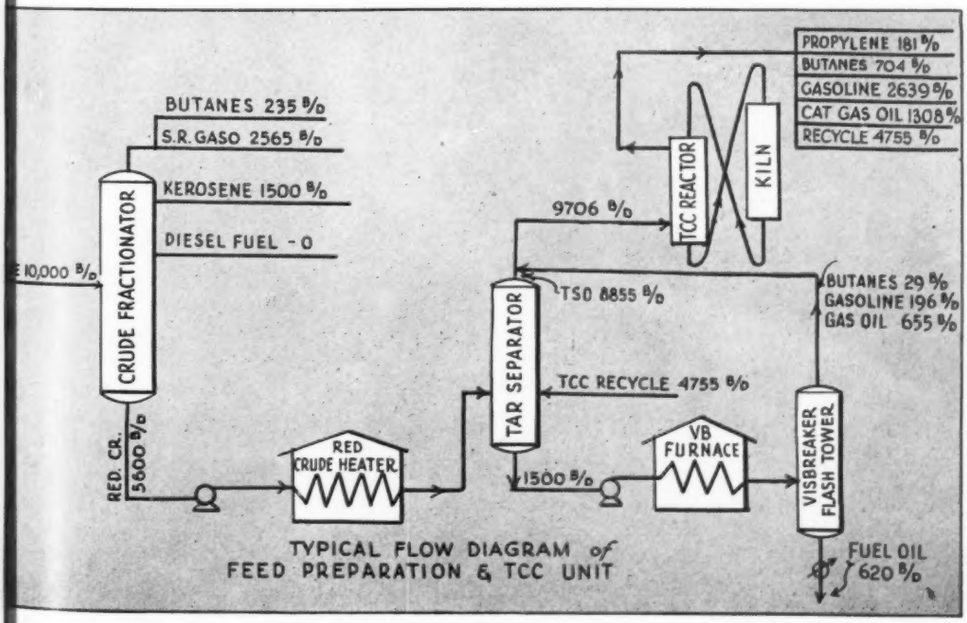
TABLE II
Assumed Price Structure and Utility Values

Stock	Price
Mid-Continent Crude	$1.40/Bbl.
Housebrand Motor Gasoline	6.25¢/Gal.
Kerosene	4.25¢/Gal.
Diesel Fuel	3.625¢/Gal.
No. 2 Fuel	3.625¢/Gal.
No. 6 Fuel	$0.90/Bbl.
Butanes	1.45¢/Gal.
Fuel Gas	$0.15/MMBtn.
Steam	$0.24/M Lbs.
Power	0.7¢/KWH
Water (Cooling)	0.5¢/M Gal.
Water (Treated)	$0.15/M Gal.
Clay Catalyst	$0.04/Lb.

The prices in this table are, of necessity, arbitrarily chosen. The individual refiner may substitute his own price structure.

On the basis of assumed price structure the earnings of catalytic cracking are seen to far exceed those of thermal cracking, with recycle catalytic cracking, which gives the highest production of catalytic gasoline, showing the highest earnings. The difference between straight thermal cracking and recycle catalytic cracking in 10 years is shown to be about $2,500,000 where 76 octane gasoline is produced, and $3,250,000 at an 80 octane level. The engineering and commercial calculations presented in this study were worked out by H. D. Noll of the Houdry Process Corporation and V. O. Bowles of the engineering staff of The Lummus Company, are equally applicable to refining operations wherever located.

As a result of this development work TCC catalytic cracking is made available to the small refiner who processes 2,000 or more barrels a day of crude oil. Since the trend is now toward higher gasoline octane numbers catalytic cracking will be in many cases the only means of reaching a competitive level. In nearly every case the earnings at a given octane level are sufficiently greater than for thermal cracking to justify its installation. The reduction of the amount of residual fuel that must be produced permits greater flexibility in meeting local market conditions. In many cases savings can be made by incorporating existing thermal equipment into the system.



TYPICAL FLOW DIAGRAM of FEED PREPARATION & TCC UNIT

The **EASY MONEY** *days are over . . .*

Wartime willingness to pay virtually anything for needed facilities is at an end. The cost-plus contract which fostered laxity and extravagance is dead . . . and its passing is not mourned either by the able and efficient engineering-construction firm nor by the conscientious buyer of processing plants and units who knows industry again must function within a highly competitive economy.

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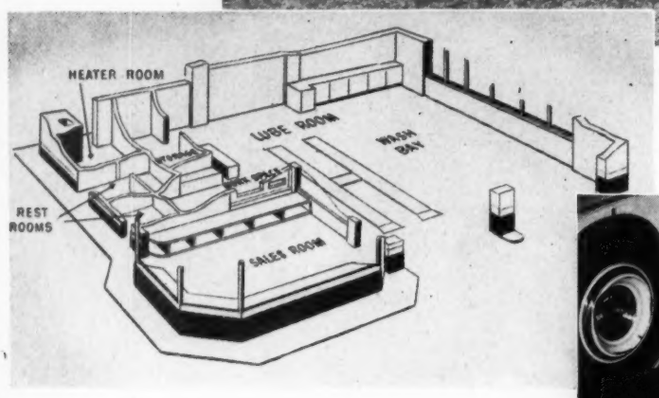
Right: New Shell Station Design is Strictly Functional.

Below: Floor Plan Shows Large Space for Service and Accessory Display.

Lower Right: Mobile Tool and Lubrication Equipment Save Service Men's Time.



UNVEILS POSTWAR STATION

SHELL OIL COMPANY recently invited friends to a house-warming, a pre-view of Shell's idea of the retail service station of the future. With Norman Bel Geddes and J. Gordon Carr as consultants in design some guests expected that the station would be decidedly streamlined, an incarnation of some of the futuristic drawings published during the war. Shell pointed out at the house-warming that functional streamlining is to reduce wind resistance of a train or plane and that the service station doesn't fly. President Alexander Fraser summed it up by saying that the new station is evolutionary rather than revolutionary.

With new building stopped during the war, Shell was able to take time to consider what the post-war station should be like. Customers were asked what they thought, 180,000 of them. Operators were consulted. Then necessary service and sales functions were performed on an open platform while time and motion studies were made. Result is that the new station in general looks quite similar to the best in pre-war design but inspection reveals many essential differences.

The new Shell station costing around $15,000 is 20 percent larger, 46 by 30 feet. Added space is centered in the salesroom and service bays. The functional design utilizes readily-cleanable, impervious building materials such as glazed brick, tile, smooth plastic and glass. The new salesroom is twice as large as before the war. Two sides are glass permitting customers to see merchandise displays and the operator to see incoming cars from any point in the room.

Perhaps the most radical change in the exterior appearance of the sales establishment from the customer's standpoint is in the gasoline dispensing pumps themselves. The housings have lost the pre-war sentinel-like appearance, they are broadly curved at the base to enclose gasoline, air and water hose reels. The height has been reduced to 54 inches with the computer dial at eye level. Customers can see the amount delivered from the car seat without neck strain. The gasoline hose reel holds 18 feet of hose, 50 percent more than pre-war, and permitting motor fuel deliveries without car jockeying.

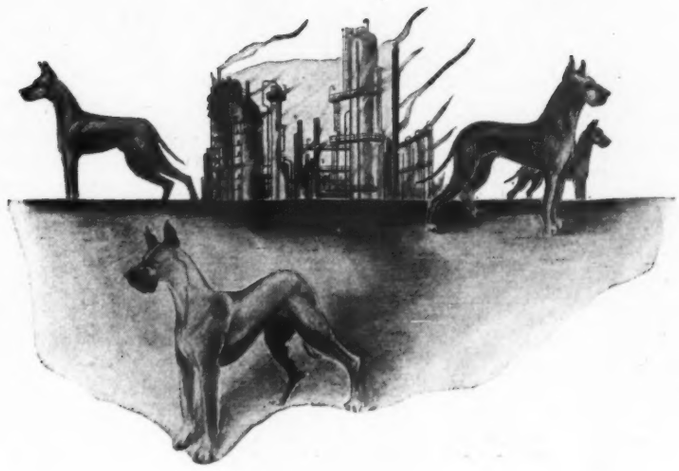
The plain wall exterior of the average pre-war station has been broken by a canopy overhang to protect stock displays against the sun and aid in night lighting of building and merchandise. By popular vote the rest rooms are at the side of the building with outside entrances.

Two service bays are provided, one with a roll-on and the other with a free-wheel lift. Overall size is 30 by 27 feet, large enough for service operations, servicing equipment and storage and display of merchandise. Four entrances to the service area are provided, overhead doors for cars, a door between these for winter access to the drive and a sliding door to the office and salesroom. This latter is to save space.

All service equipment is mobile so that tools, oil and grease can be at hand. Time and motion studies showed that output of work could be increased a third by reducing movement of the service man to a maximum of six feet. Rear wall windows are high to provide room for tire rack, storage cabinets for drums and other packages. Other windows are adequate for driveway observation.

Salesroom area is 324 square feet with office space subordinated to merchandise display. Center floor tables supplement window and shelf displays. Rearwall shelving is adjustable. Overhead shelves are available for large items. Comfortable, overstuffed chairs will be available for the service customer who wants to wait.

Shell expects its post-war dealers to enlarge their stocks of merchandise to include a good many convenience items. Minimum stock of automotive items is estimated to represent an investment of $1,385.80 and to provide an annual gross profit of $2,614.46 on a turn-over of 2.9 times



Watch Dogs of the Refinery

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CATALYTIC REFORMING	*THERMAL REFORMING*	*POLYTREATING*
HYDROGENATION	*HYDROFORMING*	*U. O. P. CATALYSTS*
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★ ★ ECHOES FROM THE WASHINGTON OIL FRONT ★ ★

By W. J. Maddox, *Chief of World Petroleum Washington Bureau*

Moreell Runs Refineries

Vice Admiral Ben Moreell

VICE ADMIRAL Ben Moreell, USN, who was designated by Secretary of the Navy Forrestal to operate the oil plants taken over by the Government because of the strikes, has been chief of the Bureau of Yards and Docks and Chief of the Civil Engineers of the Navy since December 1937. He is essentially an engineer and has received wide recognition for his work in the construction field, particularly with cement. In 1942 he received the honorary degree of Doctor of Engineering from Washington University, St. Louis, and the same year was elected to honorary membership in the American Society of Civil Engineers.

Admiral Moreell was appointed to the Navy as a result of a competitive examination in June 1917, his first duty being that of Assistant to the Public Works Officer of the New York Navy Yard. In 1937 he was Public Works Officer of the Navy Yard at Pearl Harbor, with additional duties as officer of the Fourteenth Naval District.

Among the awards Admiral Moreell has received for his engineering accomplishments is the 1942 annual award of the Moles, a society of men engaged in marine, foundation and other heavy construction, for outstanding achievement in conception, design and accomplishment; and the Henry C. Turner Medal (1943) from the American Concrete Institute for notable achievement in that field.

Rubber Policy Board Named

THE new top-eschelon interagency committee on rubber headed by William L. Batt, Office of War Mobilization and Reconversion, is now ready to start functioning. The seven government agencies designated to be represented selected the following as committee members: William L. Clayton, Assistant Secretary of State; Wendell Berge, Assistant Attorney General; W. Stuart Symington, Administrator of Surplus Property; Charles B. Henderson, Chairman of RFC; Major Gen. Sidney P. Spalding, War Department; Arthur M. Hill, Special Assistant to the Secretary of the Navy; and Francis Truslow, Foreign Economics Administration; Howard S. Piquet has been named Executive Secretary of the Committee.

In setting up the board, Reconversion Director John W. Snyder outlined the functions as to survey natural, synthetic and reclaimed rubber problems and to recommend a national policy to stabilize prices and supply, encourage the development of synthetic, and guard against the possibility of another crucial wartime shortage.

CPA Succeeds WPB

J. D. Small

ALL that remains of the functions, powers, personnel and such of the War Production Board passes November 3 to the newly created Civilian Production Administration, headed by J. D. Small, who since April has been Chief of Staff to retiring WPB Chairman Krug. The new agency, under the policy direction of War Mobilization and Reconversion, is designed to carry on merely during the transition period till industry is free of govenment controls. No termination date for CPA was set by the President but officials believe the need will hardly extend beyond the first quarter of 1946.

Any outstanding WPB regulations, directives, orders, or delegation of authority remain in full force until revoked or amended by CPA. Small explains, however, that the individual controls of which some forty remain on the books, will be lifted as soon as they are no longer needed for orderly reconversion.

Small is not going to relax on WPB's crackdown policy. One of his first acts as administrator of CPA was to send instructions to the Compliance Division "to continue its expanded investigations and other compliance activities during the next few months in order to prevent possible violators from getting an unfair advantage over the vast majority of business concerns which have always tried to comply with our orders."

The new administrator joined WPB in September 1944 as executive officer, having served as Navy materials control officer and landing craft coordinator from 1943. He was appointed chief of staff by WPB Chairman Krug last April. He headed the Committee on Period One which planned WPB's program for the transition period between the V-E Day and V-J Day and which drew up the plan for full reconversion of industry that went into effect with the defeat of Japan.

Oil Pact Meets Approval

THE new Anglo-American oil pact seems to be satisfactory to even the most violent critics of original document, and its early ratification by the Senate is likely. All the defects in the earlier draft have been remedied, and the provisions have been reduced to principles and policies with enforcement left up to the governments themselves.

Feeling among oil men is that the negotiators in redrafting the pact did all they started out to do and that the agreement furnishes something to "hang your hat on." It may lead to some cooperative action by the two countries. At least certain worthy principles are down in black and white, and if one country oversteps the mark the other can point to the document and say "Well, here's what you agreed to do."

Heads Oil Section

John A. Loftus

JOHN A. LOFTUS who has succeeded Charles Darlington as Chief of the Petroleum Division of the State Department, is widely known as an economist. He came to the State Department from OPA where he was economist and price specialist. He is a graduate of Catholic University and took his Ph. D. at Johns Hopkins, where he was associate professor in economics. Before that he was assistant professor at Holy Cross.

The new chief of the Petroleum Division was one of the official advisors to the American delegation at the recent Anglo-American oil conference. Darlington resigned the post to return to Westchester County, N. Y., to manage his farm.

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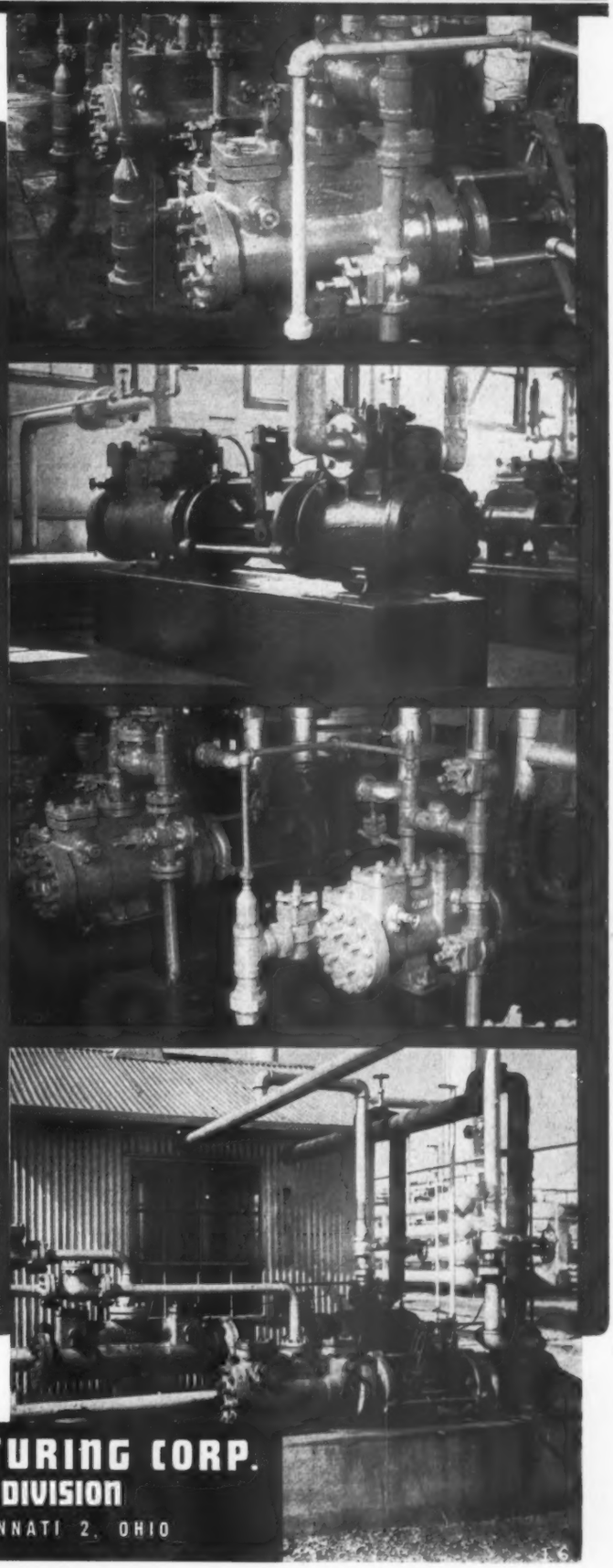

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Frame Rejoins Cities Service

A. P. Frame

A. P. FRAME, who has been director of PAW's Refining Division since June 1944, has returned to Cities Service as vice president of Petroleum Advisers, New York City, a subsidiary. In that position he will supervise the refining and development activities of Cities Service companies, including chemical research and manufacture. Before coming to PAW he was vice president and chief engineer of the Cities Service Refining Corporation.

In accepting Frame's resignation, Deputy Administrator Davies expressed his appreciation for the "highly satisfactory manner" in which the affairs of the Refining Division had been conducted during the period in which requirements of the United Nations reached their peak just before VJ Day. This was a time when the refining facilities of the entire nation were strained to the limit.

Navy's Peacetime Demand

AT its peak of operations during the war, the Navy consumed about 680,000 barrels of petroleum products a day, 27 times the amount required to keep it going during the fiscal year 1938, according to Captain Lemuel P. Padgett, Jr., at a recent session of the Senate oil investigating committee. His estimate, of Navy's post-war requirements was around 190,000 barrels a day, seven times that required during the same pre-war period. Explained Captain Padgett: "Until the post-war mission of the United States is clearly defined and as a consequence the size and responsibilities of the post-war Navy is determined, it is not practicable to predict with any degree of accuracy what the post-war peacetime naval petroleum requirements will be. For planning purposes, it has been necessary to make certain assumptions about the tasks which the Navy will be called upon to discharge in conjunction with the Army. They are three: "The first one we are sure of, namely, the security of the continental United States and its overseas possessions. The second derives from the Act of Chapultepec and is coupled with the Monroe Doctrine; it is the security of the Western Hemisphere. The third, which is the least well defined, relates to the commitments of the United States to preserve the peace of the world. "On the basis of the foregoing assumptions and for planning purposes, estimates have been made as to the size and scope of the post-war Navy. Based upon these assumptions, it is estimated, and I stress that this is an estimate in round figures, that the post-war requirements of petroleum products for the U. S. Navy will be of the order of between 60 and 70 million barrels per year of all products or about 190,000 barrels per day."

(Continued on page 10)

Twin Brothers Pass 75th Milestone

TWO men who have long been prominent in the fields of oil production and transportation and who at 75 are still more active and energetic than many only half their age observed their joint birthday on September 27. They could do this because they happen to be twin brothers—J. Edgar and John G. Pew. The former is vice president of Sun Oil Company in charge of its producing activities and the latter is president of Sun Shipbuilding and Dry Dock Company.

During the war just ended J. Edgar directed exploratory and development operations that more than doubled Sun's output of crude. John G. guided the expansion of Sun Ship and its construction of 40 percent of all the tankers built in the United States in addition to extensive refinery equipment.

Born at Mercer, Pennsylvania the two boys started their first jobs together at the age of sixteen with the Peoples Natural Gas Company in Pittsburgh. After ten years J. Edgar in 1896 joined Sun Oil Company at Toledo where the company's first oil refinery had been acquired a year before. The company, founded by J. Edgar's uncle, Joseph Newton Pew, in 1886, was growing rapidly. In 1901 when the Spindletop discovery started an oil rush to Texas, J. Edgar went there and until 1912 was engaged in securing leases, dri'ling wells and laying pipe lines to take care of the company's growing demands for crude. In 1913 he resigned to become a producer on his own account but in December of that year became vice president and western manager of Carter Oil Company.

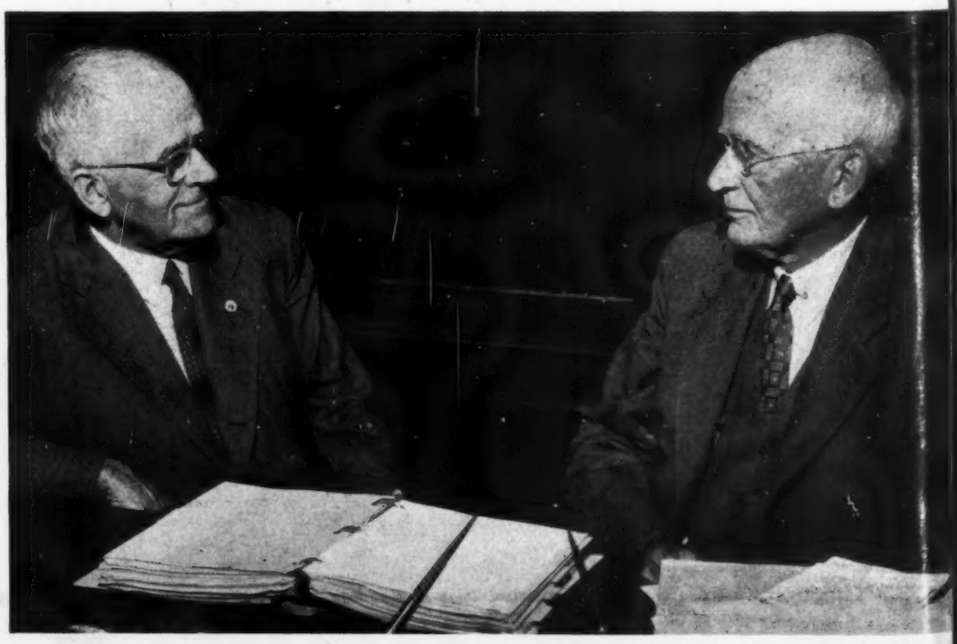
In the meantime John G. had remained with the gas company which in 1903 was purchased by Standard Oil Company of New Jersey. John G. Pew was made vice president and general manager and in 1908, at the age of thirty-eight, was elected president.

In 1918 both brothers returned to Sun Oil Company. J. Edgar was appointed vice president and John G., a year later, became president of the Sun Shipbuilding Company which under his direction pioneered two notable advances in ship building—all-welded construction and prefabrication. In 1938 the company designed the Cimarron type tanker, the fastest afloat, and early in 1942 produced for the Maritime Commission the famous T-2, the 16,500 deadwright ton model that constitutes 90 percent of all tankers built under the war program. Sun Ship's delivery of a vessel every five and a half days, won the Maritime M pennant and two stars for continuing excellence of production.

J. Edgar Pew was honored by election as the second president of the American Petroleum Institute and by being the first recipient of the gold medal awarded each year by the American Institute of Mining and Metallurgical Engineers for distinguished service to the petroleum industry. He has been chairman of the API committee on petroleum reserves from the time of its organization in 1936 and is recognized as an authority on that subject.

It is perhaps without precedent in American business life that twin brothers both have carved out such distinguished careers. It is equally remarkable that after nearly sixty years of activity both carry their responsibilities easily and are among the hardest working members of their respective organizations.

J. Edgar (Right) and John G. Pew, Two of the Best Known Pioneers in the Petroleum Industry.



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NEW PROCESSES AND IMPROVED EQUIPMENT DEVELOPED AT OAK RIDGE U235 PLANT

While the Atomic Bomb was Being Developed it was Necessary to Invent a Great Variety of Novel Accessories and Ways of Separating Gaseous Materials. A Number of These will be of Direct Use in Petroleum Refining.

MORE than 5,000 new or improved procedures, instruments or equipment were developed at the Oak Ridge, Tenn., diffusion plant engineered for the atomic bomb program by the Kellex Corporation, subsidiary of the M. W. Kellogg Company. Many of these developments will be of some great importance to peacetime industry. Some are to be released soon.

In the petroleum industry separation and purification of hydrocarbons is expected to be improved. The diffusion method developed for the separation of U235 from U238 may be employed for the separation of ethylene from cracked gases, helium from natural gas and direct recovery of gasoline from natural gas without absorption and distillation.

Equipment improvements include a new type heat exchanger, new pumps and protection against corrosion in handling products such as hydrofluoric acid.

A. L. Baker, Kellex project manager, recently described some of the Oak Ridge developments. He said that the story on pumps, the heart of the process and one of its most difficult problems, is particularly interesting and applicable to modern industry. Thousands of pumps operating under reduced pressure at Oak Ridge created problems in vacuum technique on an unheard of scale. Other thousands operated at nominal pressures. But regardless of the type or service none could leak or corrode and all had to have as small a volume as possible.

Many different types of centrifugal blower pumps and sylphon-sealed reciprocating pumps were tried out and new types developed. For example, in one of the pumps for the larger stages the impeller was driven through a coupling containing a very novel and ingenious new seal. Another type of pump was completely enclosed, its centrifugal impeller and rotor being run from the outside by induction. Perhaps the most significant advance in pump design which has been most successfully accomplished is the utilization of supersonic velocities of a very high order (Mach. numbers of over 1.0).

Literally acres of porous barriers were required for the gas diffusion plant with billions of holes smaller than 0.01 micron (about two millionths of an inch). Despite the high degree of porosity required such barriers had to be able to withstand a pressure head of one atmosphere. The pores had to be of uniform size and spacing, could not become enlarged or plugged up as the result of direct corrosion or dust coming from corrosion elsewhere in the system, and the barriers had to be amenable to manufacture in large quantities and with uniform quality.

One of the major reasons for the lack of diffusion techniques in industry today has been the barrier problem. Few, if any, corporations cared to expend the prohibitive time and money in the necessary research. Now that a large part of the basic research has been completed particularly with reference to gas recycling and instrumentation, it seems almost certain that helium will be separated from natural gas by diffusion techniques rather than by the present refrigeration method. It may be even easier to isolate hydrogen by these new methods from a number of process gases now used merely as fuel because the diffusion velocity of hydrogen is over four times that of any compound associated with it.

The isolation of ethylene from cracked gas by incorporating diffusion barriers as an integral part of cracking units could conceivably supply an abundant source of this versatile chemical used for the manufacture of synthetic rubber, plastics, antifreeze, alcohol and many other products.

The preparation of oxygen and rare gases from air without resorting to refrigeration and fractional distillation is another possible application, when economic methods are developed.

The direct isolation of natural gasoline fractions from crude petroleum without resorting to distillation, and new types of fractionating columns for the petroleum refining industry also appear feasible.

In the gaseous diffusion plant the problems of instrumentation were far greater than in any other industry because the theory involved the assumption that diffusion took place through an infinite number of stages whereas practicability dictated that such stages be limited in number. Even so, several thousand stages were required, necessitating an intricate system of gas recycling involving abnormally large volumes of gases in relation to the finished product and continuous high precision analytical control. About half of the gas processed in each stage diffused through the porous barrier as enriched U-235 product, and after repressuring was sent on to the next higher stage for further concentration; the impoverished half was also repressured and recycled through the next lower stage. The recycling involved was enormous, over 100,000 times the volume of the final enriched gas.

There were developed to meet these needs the most precise, continuous, automatic, analytical control instruments ever produced by man. This refinement is one of the outstanding features of the gas diffusion plant and constitutes one of its most important applications to industry today. Instruments which before had existed only in research laboratories were improved upon and adapted to commercial use; completely new prototypes were conceived, developed *and put into mass production*. The result is that now as never before there is available to industry a more nearly perfect system of continuous automatic control than has ever existed.

One of the developments employed is a new type of mass spectroscope which every petroleum refiner will welcome for control of cracking operations and transfer line analysis. The mass spectroscope has been employed for several years in research laboratories and even within the last two years in certain phases of the petroleum refining industry but never on the perfected scale developed at Oak Ridge. The foremost instrument engineers and physicists in this country and England devoted their full time not only toward gearing this instrument to continuous control but also to expanding this country's capacity for its quantity output.

A development, aptly and simply called "the leak detector" is more sensitive than any other existing device previously utilized for the same purpose. It played an important part in ensuring that all parts of the gaseous diffusion plant were vacuum tight. Any leaks out of or into the system would be damaging both from the standpoint of loss and contamination of valuable material. Potential uses for the leak detector include the pre-testing of pressure and vacuum apparatus before putting it in service, checking equipment in operation to ensure no wasteful loss or contamination, the testing of welds for minute pores which would otherwise escape detection and ensuring the physiological safety or refrigeration equipment employing toxic coolants.

Of great interest to the petroleum refining industry is the development of a new heat exchanger. Since an unavoidable concomitant to pumping gas is heating it and since enormous volumes of gas were processed, individual cooling units for each stage had to be developed. A brand new type of heat exchanger was conceived for this purpose and developed up to the production stage.

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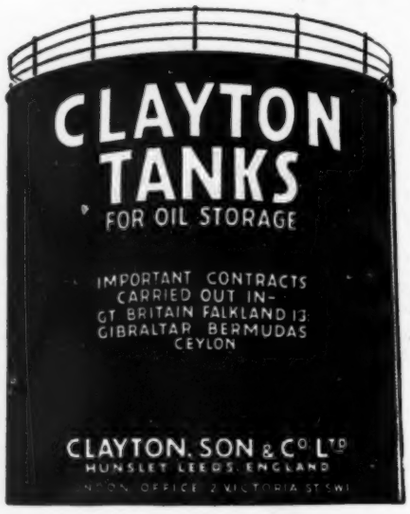

Washington Notes

(*Continued from page* 84)

Rubber Pact Coming

AN international agreement on post-war rubber is in the offing. Plans are in the making by the State Department for a further meeting of the so-called Rubber Study Group—The Netherlands, Great Britain and the United States—which met here last January. London is being suggested as the scene of the forthcoming conference, and the latter part of November as the time, although no place or time has yet been agreed on. Some thought has been given to inviting other rubber-interested nations to participate, but the probability is that the group will be kept tripartite. State Department officials admit that others, including France and India, will have to be brought in eventually if there is to be a real international agreement, but they feel that to expand the group now would make it unwieldy.

British Trade Rule Criticized

ALTHOUGH Senate approval of the Anglo-American oil pact appears assured, a group of Senators including Ed Moore of Oklahoma are hot over the British requirement that materials and equipment used in the United Kingdom be acquired within sterling sources, and they are prepared to sound off when the treaty comes up for discussion. Moore claims that the British in taking this attitude are violating Article II of the pact before it is even ratified. At the instigation of PAW, the senior Oklahoman is turning the heat on Will Clayton, Assistant Secretary of State for Economic Affairs.

In reply to complaints registered by PAW on behalf of American oil companies, the British Ministry of Fuel and Power, said that the order is a major policy of the government and American nationals should not expect it to be rescinded. In a recent letter to Clayton, his third within a month, Moore said:

"Instances of extensive property loss, as well as serious competitive handicaps being suffered by American nationals, are multiplying so rapidly that it seems appropriate for our government to take some immediate affirmative action. The British order is, in effect, a virtual confiscation of American interests. For example, terminal and distribution facilities of an American company, partially destroyed by war, remains idle and suffers further deterioration while a British company builds competing facilities with materials and equipment purchased in the American market.

"Another example brought to my attention is the inability of an American national to export drilling equipment to the United Kingdom to comply with drilling obligations under the oil concession held by this national. Failure to comply with such obligation, of course, endangers the validity of the concession. The necessary drilling equipment is unobtainable from sterling sources. Similar examples of hardships resulting from the discriminatory order of the British could be cited.

"In my opinion, it would be entirely appropriate to request the British government to grant American nationals relief in this connection as a condition to further negotiations for post-war financial aid to Britain. Such action would be only a reasonable protection of American interests."

Some Solons look on the order as part of a British move to set up trade barriers to press the United States into lending more money for restoring their trade, giving it an advantage our nationals may never overcome. The Senators held off their attack while Secretary of State Byrnes was in the throes of the London conference of premiers, as they felt we could not at that time afford to have a row with the British Labor government.

Continue Alaskan Drilling

ALTHOUGH Navy has not found any commercial oil yet in its exploratory drilling on the Point Barrow reserve in northenmost Alaska, the well now being drilled gives indications of "being in oil country." During the war the work was carried on with Navy personnel, and Navy is now in the process of switching over to civilian personnel. A large number of the men it had in Alaska were older men in the Seabees, technical, and experienced men who, the Navy says, were entitled to get out of the service quickly. Negotiations are under way for continuing the work through civilian contractors.

Subsidy for Non-Production?

HERE'S an idea recently thrown out here by an oil man for conserving reserves in this country and at the same time overcoming objections of domestic producers to imports of foreign supplies. In the first place he scouts the suggestion made now and then of stockpiling oil in the United States by pumping down reservoirs. He objects to this on the ground of hazard and expense.

But—he does believe that foreign oil might be brought in and substituted for oil in the ground. For every barrel of crude brought in and used, keep in the gound a barrel of domestic oil that otherwise would be produced. He says it would be necessary to close in some domestic fields and that a subsidy for cost may be required. Probability is that high-cost fields would be forced to close.

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Ickes and Davies Honored

IN tribute to the highly efficient and successful organization of the government's services in mobilizing and directing petroleum activities during this war and to the cooperative attitude of the leaders in tha work, in aiding the industry to meet its many difficult problems, the Petroleum Industry War Council gave a testimonial dinner to Petroleum administrator Ralph K. Davies at the Hotel Statler in Washington, on October 23. Commemorating the occasion, bronze medals, marking the industry's appreciation, were presented to the two distinguished guests.

The dinner was a celebration of effective teamwork of industry and government throughout the struggle and of its highly successful results in meeting the tremendous petroleum requirements of the United Nations which led to early and overwhelming victory. It was likewise a farewell party for the two groups that have worked together closely and harmoniously for the past four years and that are now nearing the end of their activities.

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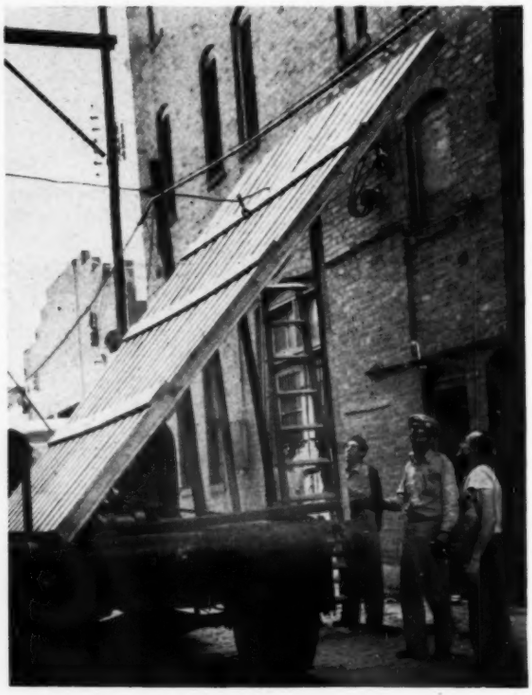

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State of New York }
County of New York } ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared Rex W. Wadman, who, having been duly sworn according to law, deposes and says that he is the general manager of the WORLD PETROLEUM and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Mona Palmer, Trustee under the will of Russell Palmer, 2 West 45th St., New York 19, N. Y.; Editor, E. W. Mayo, 2 West 45th St., New York 19, N. Y.; Managing Editor, J. C. Chatfield, 2 West 45th St., New York 19, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and adresses of stockholers owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Mona Palmer, Trustee under the will of Russell Palmer, 2697 Tanoble Drive, Altadena, Calif.

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4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the ompany as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

REX W. WADMAN
(Signature of General Manager)

Sworn to and subscribed before me this 2nd day of October, 1945.

[SEAL.] ELIZABETH M. DONLON
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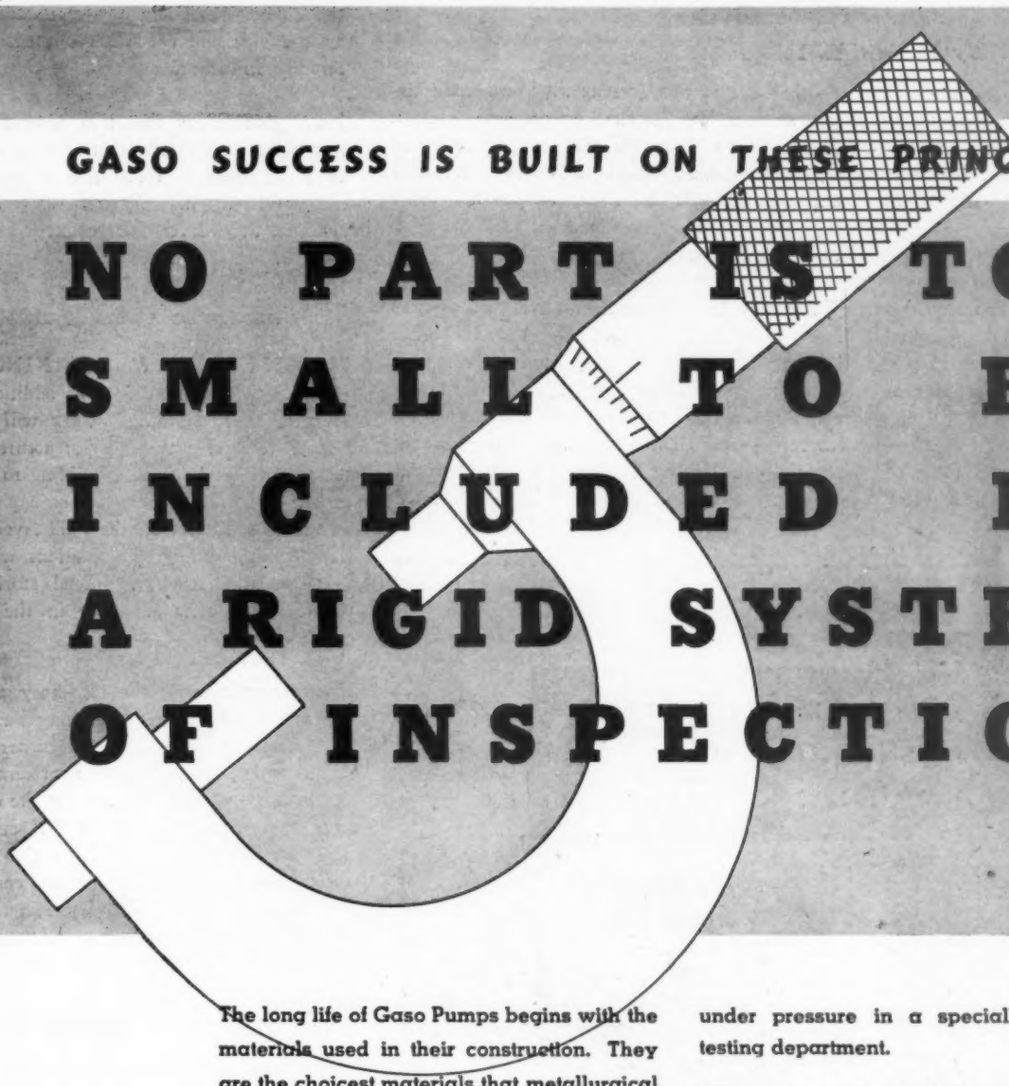

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Administrator Praises Advisers

By Harold L. Ickes

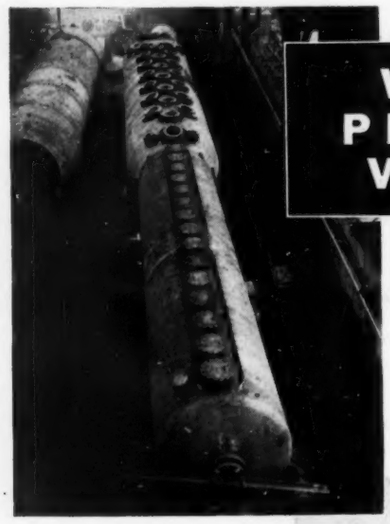
WHEN I signed the revised Anglo-American Petroleum Agreement in London on behalf of the Government of the United States, it was with the comforting knowledge that here was a document which would have the support of our American oil industry.

It is not necessary to recall to any oil man—or to any of us in Government who had anything to do with the agreement—that the original document, signed in Washington on August 8, 1944, did not have the enthusiastic support of petroleum spokesmen.

The representatives of industry and those of Government slugged it out with no little vigor on the issue of this agreement. We became impatient with one another on occasion. But, it pleases me to believe that that is the democratic way, the American way. In any event, we came out with a revised agreement which both sides supported. That is the document that we took to London with us.

There went to London, also, a group of advisers from the Petroleum Industry War Council: William R. Boyd, Jr., A. Jacobsen, George A. Hill, Jr., W. Alton Jones, Joseph E Pogue and Ralph T. Zook. We took them because we suspected—and rightly—that the British would not simply sign our paper as it was, without deleting a comma or crossing a T. We wanted the industry to know of any changes requested by the British. We wanted them to be continually informed.

I am glad to say that they gave their advice, they were kept informed, and they are satisfied with the product. I am glad to say, also, that they served the industry well, as good oil men; and that they served their country well, as good citizens.



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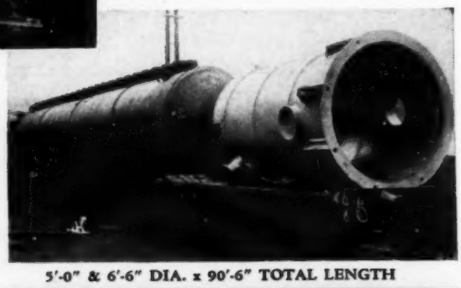

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Alco Buys Beaumont Works

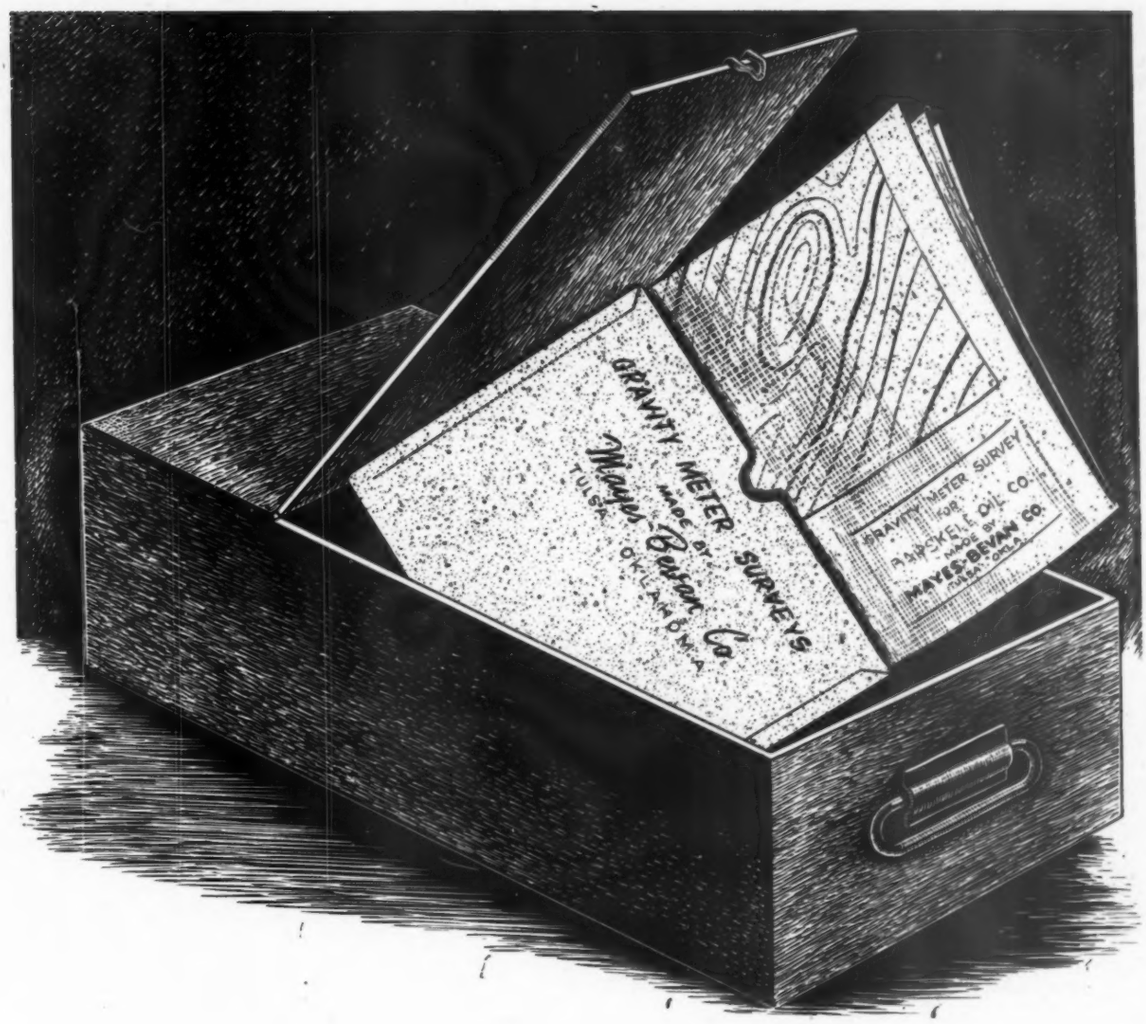
THE American Locomotive Company has purchased the Beaumont Iron Works Company, Beaumont, Texas, and will continue to manufacture the oil field equipment formerly made by Beaumont. Distribution will be through The Jones and Laughlin Supply Company.

The New Petroleum Register

THIS standard annual directory and register of the active oil companies of the world gives their history, capital and corporate structures, their affiliations and subsidiaries, concessions and properties, their directorates and personnel, manufacturing facilities and their means of transportation and distribution.

The present edition is the 24th, and, as usual, contains much pertinent information relative to oil companies and individual operators all over the world, which is mostly not to be found in any other source.

The book is a substantial volume of 750 pages, 11¾" by 8". It is priced at $10.00 per copy domestic, $12.00 foreign. Orders should be sent to Book Dept. World Petroleum, 2 West 45th Street, New York 19, N. Y.



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WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing with Technical and Economic Aspects of the Petroleum Industry — Edited by Dr. O. W. Willcox.

OPERATION

Thermal Principle Applied to Secondary Oil Re-

Anthony Gibbon, in OIL WEEKLY, Vol. 115 (1944) No. 10—pp. 170-172.

Experiments have been made in which superheated air is forced into a depleted oil formation through a centrally located input well somewhat in the manner of secondary recovery by artificial gas or air drive. The idea of using hot air instead of cold air is mainly that the heat reduces the viscosity of the oil in the pores of the formation, which should result in a freer movement of both gas and oil to the producing wells and hence result in a greater recovery.

A first experiment was made on an abandoned oil field in Oklahoma containing 30 old wells which were producing about 4 bbls. of oil a day each. By means of a compressor and superheater which consumed about 40 bbl. of oil a day, air heated to 1200° F. were injected into the old 20-ft. oil sand at a depth of 600 ft. at the rate of 150 cu. ft. a minute. Ten days after beginning operations a well 660 ft. distant showed an increased oil flow and in two weeks eight other pumping wells in a radius of 1200 ft. started to head up and flow. Approximately 2700 bbl. of oil was gained by the end of 40 days, when the project went entirely to water from a nearby water-flooding project.

The unit was then dismantled and moved to a location over a heavy, asphaltic-base crude oil at a depth of 1000 ft. The input well was the center of a 5-well pattern, all dead. Here the four wells developed large volumes of gas and some oil, then the equipment (made of junk material) failed. The experiments will be resumed when heat-resisting steel is available. It is estimated that a plant to work a 160-acre lease where the oil sand is at a depth of 1000 feet will cost about $15,000.

Note: This idea should not be confused with the thermal process of producing oil formations conceived by some Russian petroleum technologists around 1934. This Russian idea was to charge the bottom hole of the input well opposite the drained-out oil sand with wood charcoal, which would be electrically ignited from the surface; combustion thus started would be supported by air forced in by a compressor. It was postulated that the fire would "take" on the residual oil between the sand grains and, urged on by the draft of air, would spread through the formation, driving the oil to the producing well in the form of liquid petroleum and partly cracked oil vapors and gas. The idea was tried out on an "artificial oil formation" consisting of a long 20-inch pipe packed with sand with a crude oil saturation of about 40%. A vertical tube at one end represented the input well and a similar tube at the other end the producing well. Fire was started in the "input well" and supported by compressed air. Net recovery in this experimental installation was around 90% of the total saturation. Plans for a field test were made and a book was published on the subject, but no further information on the proposition has come out.

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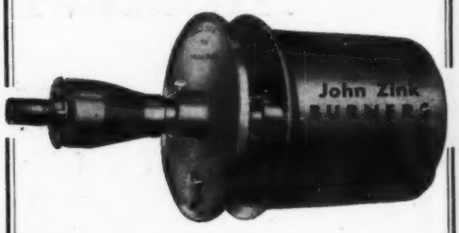

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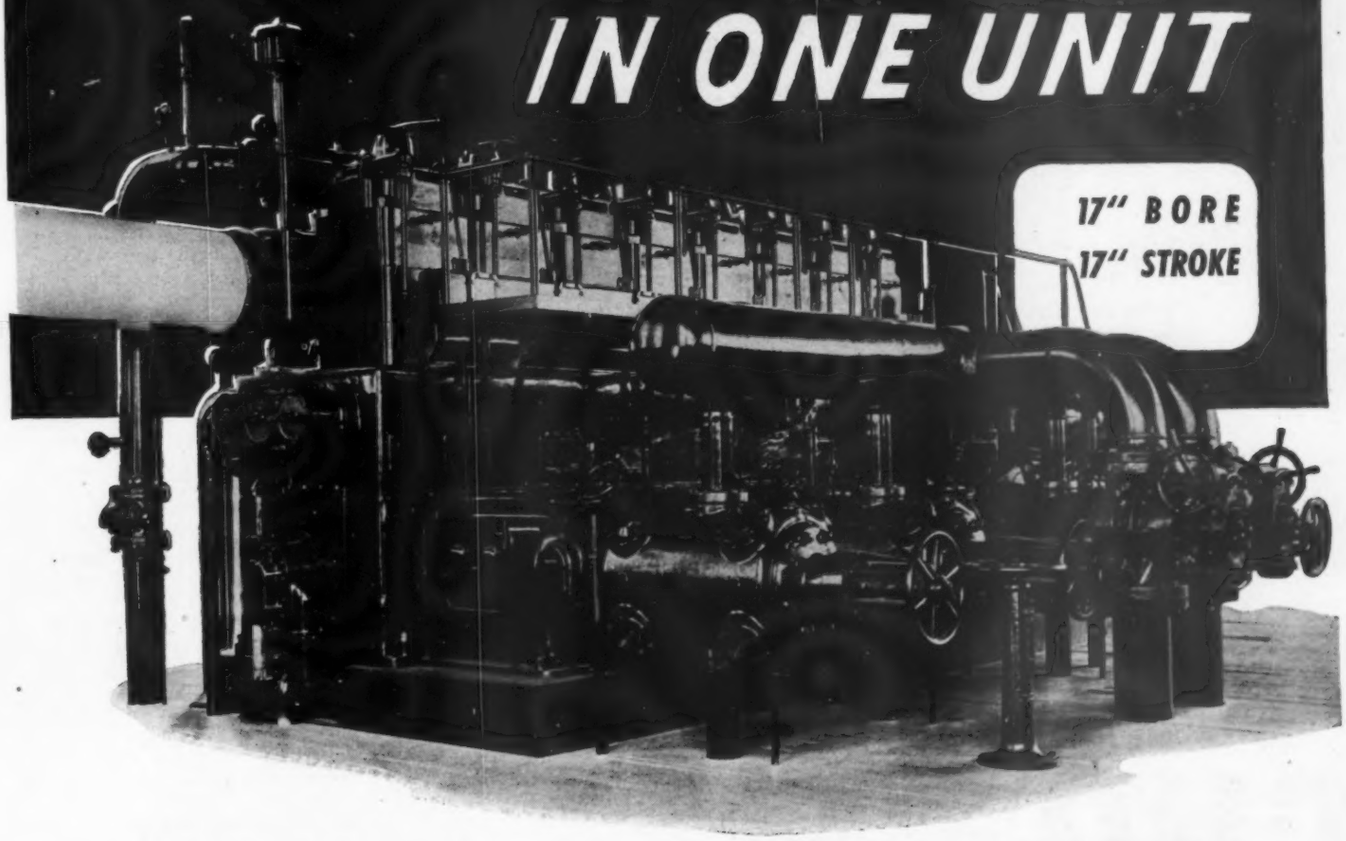

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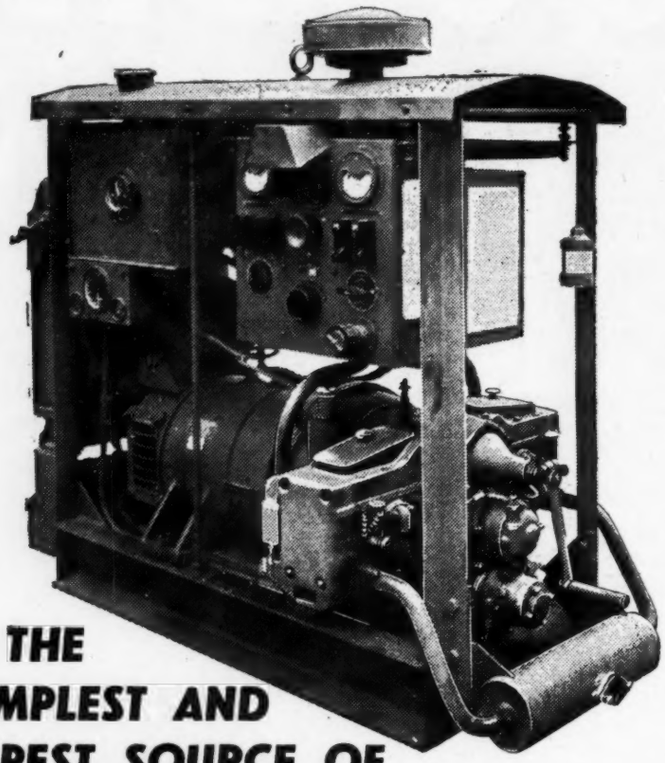
REFINING

Cracking with Catalysts—C. G. Thomas and others, in Universal Oil Products Bulletin No. 254, 16 pages, 1944.

This paper discusses some of the fundamental principles of cracking catalysts, gives some typical results over rather wide ranges of operating conditions and charging stock quality, and describes certain important developments of the present commercial design of the Universal Oil Products Company. These developments relate to what is called "polytreating", which comprises second-stage liquid-phase treatment of catalytically cracked gasoline in the presence of a UOP solid catalyst. It constitutes a third finishing method for such gasolines. Previously developed finishing methods include contacting high-temperature catalytically-cracked gasoline in gaseous phase with a synthetic silica-alumina catalyst in the temperature range of about 700 to 900 deg. F.; this reduces the olefin content by hydrogen transfer, and causes some isomerization. The second method of removing olefins from gasolines is sulfuric acid treatment, which does not result in the same degree of improvement as attained by the catalytic processes. The third or UOP polytreating method is a liquid phase process and gives results comparable to those of the sulfuric treatment. The prime feature of the UOP process is the long life of the UOP catalyst, which makes it economically attractive.

In conclusion the authors speak some comforting words to the small refiner who may be alarmed by the prospects of competition from the existing huge, war-born catalytic installations. They say that it is a foregone conclusion that after the war the benefits of the refinements that have gone into the costly commercial installations will be embodied in plants of the future to fit the capacity and the pocket-book of the small refiner.



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NATURAL GAS

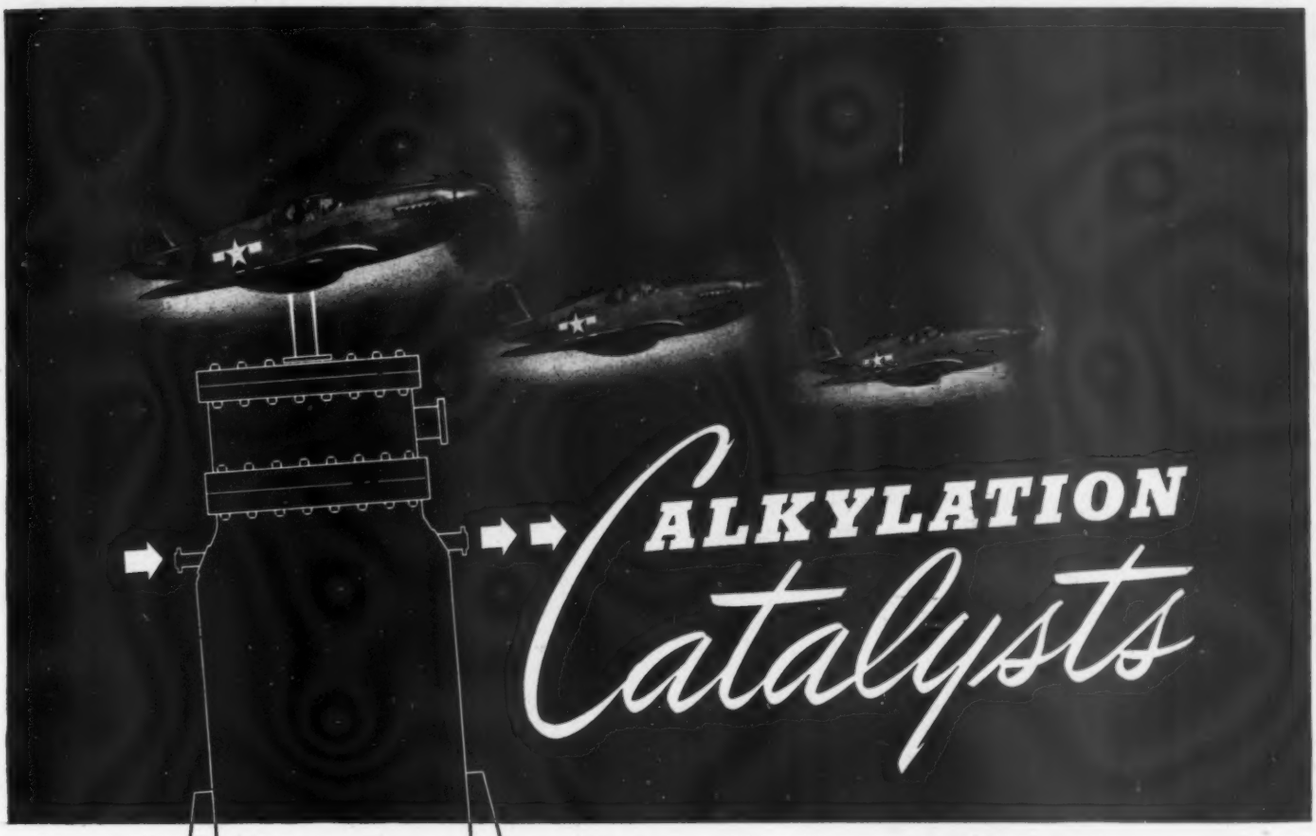
Use of Portable Gas Compressor Units (Reciprocating Type)—Paul E. Dufendach, before AMERICAN PETROLEUM INSTITUTE, Production Division, Columbus meeting, April 1944.

The Appalachian area is profuse with small production lenses or formations and individual wells in which the sand pressure has declined to a point where little or no production is obtained with the prevailing line pressures. The amount of gas recovered and the rate of delivery from these small isolated cases would be substantial if lower line pressures were maintained, but it would not be economical in many cases to increase the capacity of large compressor stations or to increase the capacity of lines serving this potential production.

The relation between demand and supply of natural gas in the Appalachian area being what it is, the gas in these small pockets is needed, particularly for sustaining winter peak loads, which apparently will become greater as time goes on. In these small low pressure areas the installation and operation of small compressor units would enable the marketing of the gas. First consideration, of course, would be the economical aspects of such operation. If a study of low-pressure gas sand indicates a limited reserve which would last only a short time, a permanent installation of compressor units would not be economical. But in such cases an alternative would be to use portable, low-cost compressor units which could be picked up and removed to other locations when the gas in the lens has been exhausted.

Various subsidiary advantages are pointed out. By exhausting a gas well more rapidly (shortening its life) a saving in overall total operating cost is effected; shallow gas might be expeditiously exhausted so that deeper drilling can proceed earlier. A portable unit might be made to replace a large compressor in a nearly exhausted field so that the big unit may be used elsewhere. In that case a large diameter pipe line might also be salvaged by replacing it with a smaller one.

Complete portable gas compressor units approaching 100 brake H.P. are available at a cost of $75.00 or $80.00 per H.P. Some units are now being operated with an average attendance of four hours a day. The total cost of compression with the portable unit may vary from about 2C per MCF with high compression ratios to less than ½¢ with low ratios.



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GENERAL

Post War Uses of the War Emergency Pipe Lines for Petroleum Transportation—T. E. Swigart, in PETROLEUM TECHNOLOGY, Technical Publication No. 1757 (1944) 28 pages.

This long paper contains a very thorough analysis of the probable post-war economic status of the two war emergency pipe lines It is supposed that there may be a strong demand by the public, Congress, and the executive branch of the government to maintain these lines in operating conditions after the war, and it will be desirable to do so if they can be shown to have a place in the economic life of the country and can be operated by industry.

The most obvious use for the lines would be the movement of crude oil and its products from Texas to the East Coast; for this business they will have to compete with tank ships. Their location also enables them to handle movements into District 2, for which they must compete with existing privately owned pipe lines and river barges. It is assumed that the government will sell the lines at fair prices; taking into account accrued depreciation, it is considered that the 24-inch line is now worth $60.000,000 and the 20-inch line $39,000,000, or $97,000,000, for the two; it is further assumed that private capital will not make this investment unless assured of earnings at 7 percent plus annual depreciation cash to pay out in 8 or 10 years.

After analyzing the large number of factors that bear on the problem it seems clear that these lines will have difficulty in meeting competition. Even if the Government were willing to consider its investment returned by savings during the war or were to regard any unreturned part of its investment as monies spent for the war program, the 20-in. line could not compete with tankers for Gulf to East Coast products transportation on a marginal or out-of-pocket basis; the 24-in. line could meet tanker costs only if enough East Texas crude or combined East and West Texas (by direct pipe line haul) were tendered for transportation to give it a high load factor. It is within the realm of probability that enough total petroleum business could be obtained to give one segment of one line an economic load into District 2 and it may be possible for industry to utilize a segment of one line for this purpose.

The Government doubtless would not consider the subsidizing of these lines as prudent or justifiable, as such action would not only harm business but could reduce the American tanker fleet and thus conceivably prove more detrimental to the national safety in the future than even the abandonment of the pipe lines.

BOOK

Index Fossils of North America—by Robert R. Shrok and Harvey W. Shimer. Published 1944, by John Wiley & Sons, Inc; 837 pages, 7½" x 10½"-$20.00.

This substantial volume is a revision of Grabau and Shimer's "North American Index Fossils" and includes all the latest work up to Pearl Harbor; it contains over 9400 illustrations on 303 full page plates, and about 7500 species are described and figured. Geographic as well as geologic distribution is considered, and selected bibliographies for all the larger divisions are given.

The general aim of the book is to describe those fossils best adapted for the determination of geologic horizons. It is clearly a work that will be useful to the working geologist in his task of identifying faunas and correlating strata.

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